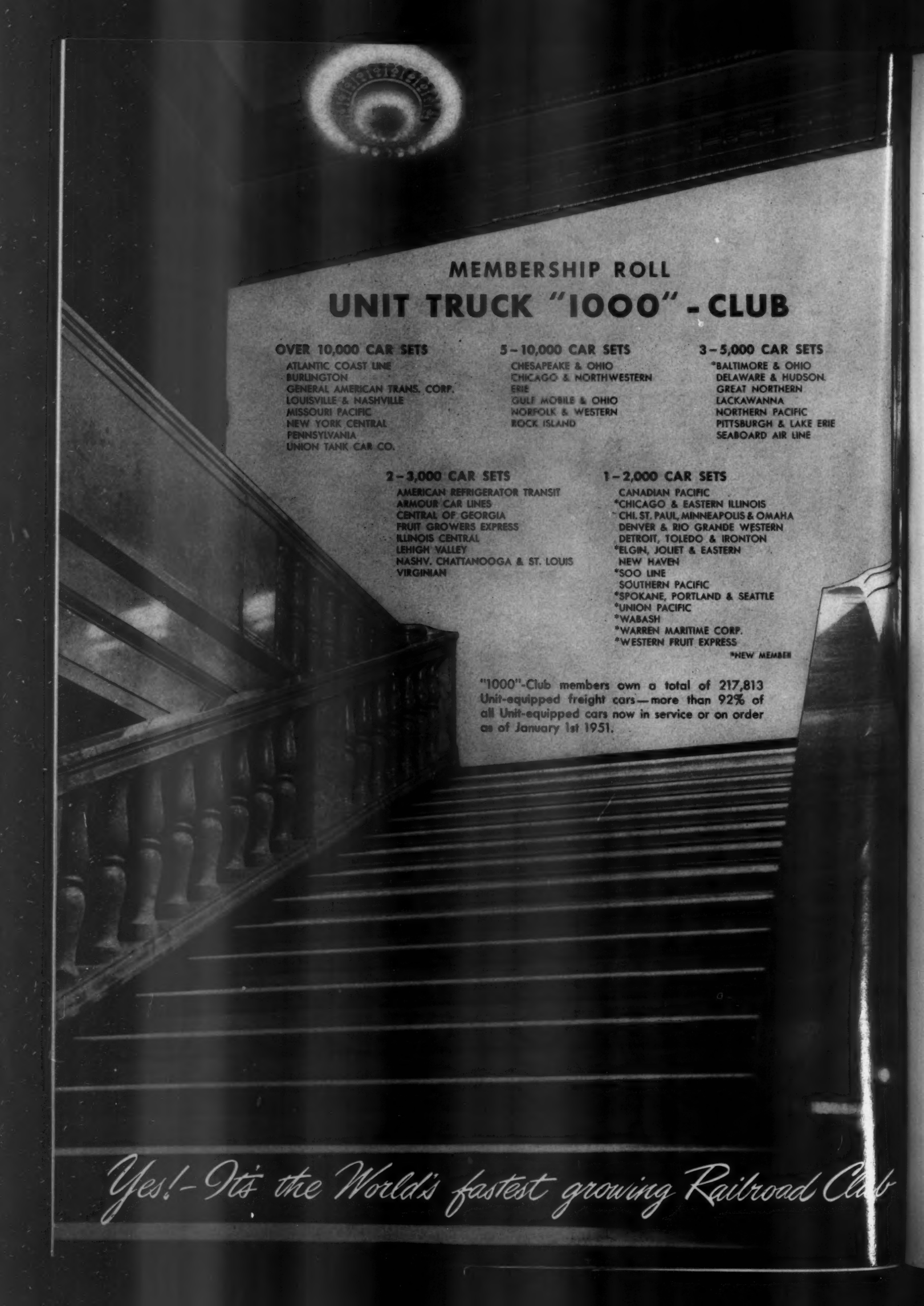
RAILWAY Mechanical and Electrical Engineer

FEBRUARY, 1951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RAILWAY Mechanical and Electrical Engineer

Founded in 1832 as the American Rail-Road Journal.

VOLUME 125 No. 2

Published monthly by Simmons-Boardman Publishing Corporation
1309 Noble street, Philadelphia, Pa. Editorial and executive offices: 30 Church street, New York 7, and 79 W. Monroe street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D. C.; 1914 Minor avenue, Seattle 1, Wash.; 816 W. Fifth street, Los Angeles 13, Calif.; 2909 Maple avenue, Dallas 4, Tex.

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The Railway Mechanical and Electrical Engineer is a member of the Associated Business Papers (A.B.P.) and the Audit Bureau of Circulations (A.B.C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service. Printed in U. S. A.

Subscriptions payable in advance and postage free, United States, U. S. Possessions and Canada, 1 year, $3. Other countries in Western Hemisphere: 1 year, $5; 2 years, $8. All other countries: 1 year, $7; 2 years, $12. Single copies 50 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York 7.

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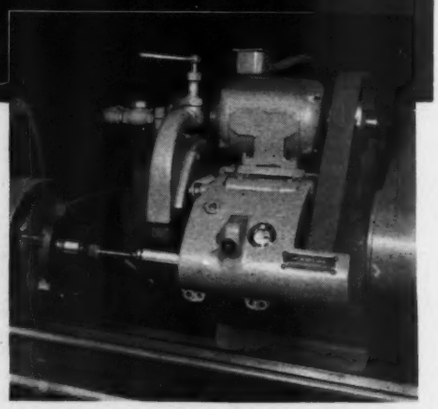

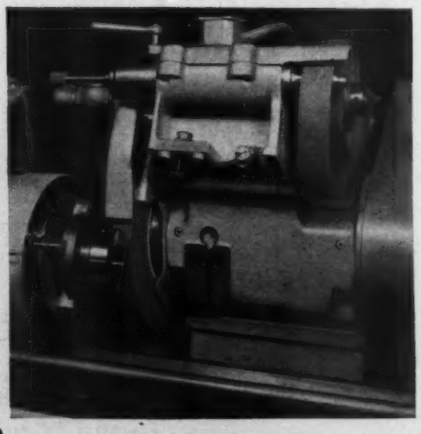

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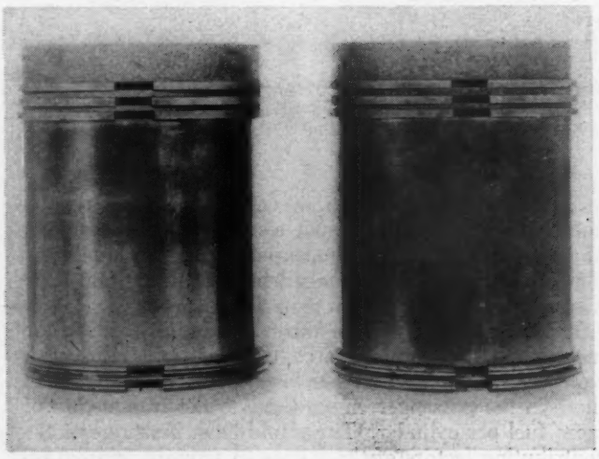
RAILWAY Mechanical and Electrical Engineer

Heavy-Duty Diesel Oils*

By Wayne Lasky, M. A. Hanson and H. E. Frank†



Pistons from 1,000-hp. passenger engine. Left—heavy-duty oil. Right—straight mineral oil.

THE FIRST diesel engines on the G. M. & O., placed in passenger service in 1935, used a straight mineral oil. It was found necessary to renew pistons and liners every 25,000 miles and to change lubricating oil every 2,500 miles.

Laboratory analyses of periodic crankcase oil samples indicated that better oil quality would be maintained if filtering of the oil could be accomplished on the locomotive. Waste packed filter elements were applied.

Filter paper spot tests were used as a measuring stick of oil cleanliness. The filter paper selected for use was a .023 in. thick filter press paper.

The improved oil cleanliness by filtering also improved engine conditions. Piston and liner life was extended to 100,000 miles. Oil drain mileage was progressively increased from 2,500 to 100,000 miles and finally the oil was changed only at times of excessive contamination with fuel oil, water or a mechanical failure. Credit for a portion of the improved engine conditions should probably be given to improved injection equipment which was installed at almost the same time as the filters.

The engine parts in the hot areas were generally quite heavily lacquered and sludge deposits were rather heavy in the cooler locations of the engines. This was accepted as a normal condition.

In 1945, a number of new diesel passenger locomotives were purchased. At that time one of the oil companies offered a heavy-duty type oil which was placed in these engines and immediately differences were noted in the characteristics of the lubricating oil samples removed from the crankcases. The filters did not keep the oil visibly clean. Blotter spot tests, which had been used for the control of filter changes, no longer appeared to have any value since the oil did not become clean by frequent and repeated changing of the filters.

Lubricating oil changes were being made every 50,000 miles in accordance with manufacturer's warranty recommendations; however, it was noticed that the oil was maintained considerably cleaner toward the end of the oil change period than at the beginning.

When these engines were out of warranty, it was decided to extend the oil mileages on one of the units. Crankcase oil conditions were closely followed. This included the determination of additive metal in the ash at periodic mileages.

Figure 1 is a graph of the analyses of the calcium content of crankcase oil samples plotted against mileage. It will be noted that the percentage of additive metal in the oil dropped rather rapidly during the first few thousand miles of service and then remained at a uniform concentration for an indefinite period.

It was generally accepted that the percentage of additive metal present in used oil samples was indicative of the original additive remaining in the oil. It appeared

Pistons from 1,500-hp. freight engine, with heavy-duty oil. Left—fortification test. Right—30,000-mile oil changes

* Abstract of a paper presented before the Society of Automotive Engineers, National Diesel Engine Meeting held at Chicago, November 2-3, 1950.

† Engineer of tests, engineer of research and chief chemist, respectively, Gulf, Mobile & Ohio.

that the additive in the make-up oil used was sufficient to maintain the additive concentration in the crankcase at a constant value.

After 155,000 miles of service it was necessary to remove one cylinder assembly from the engine on extended oil mileage, due to a parts failure. The condition of the piston, the rings and bearings was so much better than any previously inspected that the benefits from heavy-duty type oil were clearly established. At that time it was decided to extend the oil mileage on all these engines and to change oil in the crankcase only as required by fuel dilution, water in the oil or a parts failure. Some engines were operated 300,000 to 400,000 miles between oil changes. Extended oil mileages on these engines resulted in no particular engine difficulties. The condition of the removed parts were excellent and the engines remained reasonably clean, in fact, much cleaner than had been previously possible with straight mineral oil.

Late in 1946 the railroad purchased its first freight diesel locomotives equipped with higher output engines. Some of these engines were identical to the passenger engines except that they had more cylinders and the

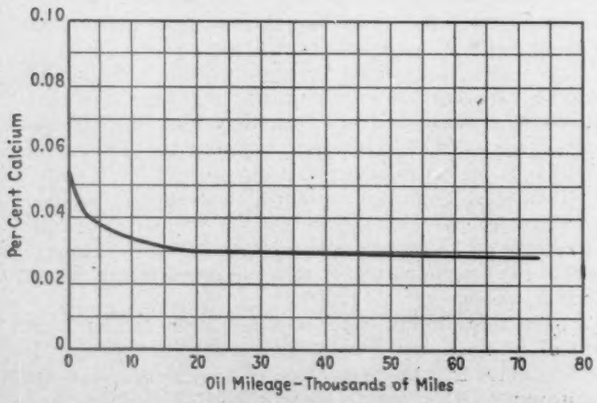


Fig. 1—Calcium content of crankcase oil plotted against mileage. Samples from a 1,000-hp. passenger diesel. The calcium present at the end of the test was about 60 per cent of that in new oil

horsepower output per cylinder had been increased approximately 12 per cent by the injection of more fuel per power stroke.

The oil was changed in these engines every 30,000 miles during the warranty period. A portion of the engines was lubricated with straight mineral oil but it was soon found that this type oil was not satisfactory. Although the oil could be kept clean by periodic filter changes, the engine parts became heavily coated with lacquer and sludge. Heavy sludge deposits accumulated on the top decks and crankcases. A heavy build-up of carbon and lacquer was experienced on the valve stems contributing to valve blow-by and stuck valves. Compression rings were found stuck and oil control rings filled. Oil grooves in the piston pin bushings also became filled, thereby preventing adequate lubrication and causing seizure of the bushing to the rod eye and/or piston pin.

Oil cooler passages became partially filled with sludge which resulted in higher crankcase oil temperatures. Higher oil temperatures in turn resulted in a more rapid rate of sludge and varnish formation. The oil became

Piston pin bushings from 1,500-hp. freight engine. Left—heavy-duty oil. Right—straight mineral oil

increasingly reddish-brown in color which was readily noticeable on the blotter spot tests. Frequent changing of lubricating oil filters appeared to remove the black portion of the sludge in the oil but seemingly had little effect on the reddish-brown material.

It was suspected that in the high output engines, the moving parts in the piston area, that had to be lubricated, were operating at a higher over-all temperature than those in the passenger engines due to the combustion of more fuel per cylinder. This could have been one of the contributing factors of the failure of straight mineral oil to lubricate these high output engines satisfactorily.

In a short time, all of the diesel freight locomotives were assigned to heavy-duty type oils which were being obtained from three different suppliers.

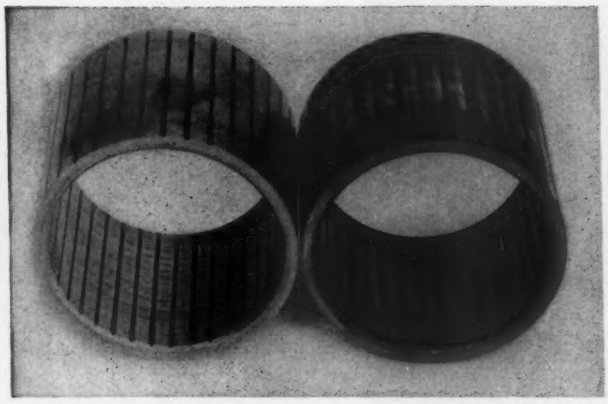
Since satisfactory and economical lubrication had been experienced with these oils in passenger engines on extended oil mileages it had been planned to place these high output freight engines on extended oil mileages after the warranty period.

However, it was soon discovered that after 30,000 to 35,000 miles the oil in the crankcase appeared to have properties similar to straight mineral oil. Continued operation of the engine without changing oil produced unsatisfactory engine conditions similar to those experienced when using straight mineral oil in these high output engines. There was no noticeable difference in the results experienced with any one of these heavy-duty type oils used.

Analyses of periodic oil samples removed from the crankcase indicated that the oil became less oxidation stable, and lost its dispersant qualities rapidly between 20,000 and 30,000 miles.

Figure 2 shows the analyses of naphtha insolubles, also the chloroform soluble and chloroform insoluble portions of the naphtha insolubles. The determinations were made at periodic oil mileages of crankcase oil samples removed from a 1,500 hp. freight engine, lubricated with heavy-duty oil, from the time the oil was applied to approximately 50,000 miles of service.

For interpretation of the oil conditions we shall assume the naphtha insolubles roughly represent the total sludge contaminants in the oil. The chloroform solubles indicate the amount of oil oxidation products such as resins, gums, acids, etc. The chloroform insolubles are a measure of the carbon or soot "blow-by" contained in the oil. Of course, in every instance the naphtha in-



Piston pin bushings from 1,500-hp. freight engines, with heavy duty oil. Extended oil mileages. Left—with fortification. Right—without fortification

solubles equals chloroform solubles plus chloroform insolubles.

The naphtha insolubles increased rapidly during the first 6,000 miles, however the naphtha insolubles consisted mainly of chloroform insolubles indicating only a small amount of chloroform solubles was being produced by the engine due to good oxidation stability. The rapid increase of chloroform insolubles in the oil was due to the high dispersancy which kept the sludge suspended in finely divided particles that were not removed by the filter.

After 6,000 miles the naphtha insolubles decreased rather rapidly for about 4,000 miles indicating that the sludge was being removed by the filters, probably due to the oil becoming less dispersant. This condition correlates with the rather rapid drop in additive concentration during the first few thousand miles as was shown in Fig. 1.

From about 10,000 miles to 22,000 miles the chloroform solubles increased at a low uniform rate indicating fair oxidation stability. The chloroform insolubles remained rather constant showing satisfactory dispersant qualities.

After 22,000 miles the amount of chloroform solubles increased more rapidly indicating lower oxidation stability. The chloroform insolubles decreased rather rapidly showing lower oil dispersancy, enabling the filter to remove the carbon and soot more completely. By the time the oil was drained at 48,000 miles, the naphtha insolubles consisted almost entirely of chloroform solubles.

It was concluded that the increased rate of oxidation and loss of dispersant properties were due to loss of additive effectiveness which was responsible for the unsatisfactory lubrication of these engines when operated more than 30,000 miles between oil changes.

Laboratory oxidation bench tests of the periodic oil samples also indicated the oxidation stability of the oil decreased with service miles. No satisfactory laboratory test was developed to measure the relative dispersant qualities of the oil; however, it was found that the appearance of the oil spots of the blotter spot test changed gradually as the oil mileage increased.

Blotter spot tests of crankcase oil samples taken from 1000 miles to 46,000 miles of service showed that after about 11,000 miles, the oil became progressively less dispersant as the mileage increased. This was indicated by the smaller diameter of the black portion of the spot until the black portion disappears entirely. Oil oxidation products increased with mileage as indicated by the gradual change of the outer portion of the spot from a pale yellow to an orange-brown. After correlating numerous spot tests with actual oil analyses it was possible to determine when the filters should be replaced and also possible to

TABLE I—LUBRICATING OIL COSTS. 1,500 HP. FREIGHT ENGINE; 200 GALLONS CRANKCASE CAPACITY; 12 GALLONS PER 1,000 MILES OIL CONSUMPTION; 90,000 MILES SERVICE

30,000 Mile Oil Changes

	Gal.	Cost Per gal.	Cost Total
3 oil changes	600	$.50	$300.00
Make-up oil	1080	.50	540.00
Total			$840.00
Crankcase Fortification			
1 oil change	200	$.50	$100.00
Make-up oil	810	.50	405.00
Fortification agent	270	.65	175.50
Total			$680.50
Saving (19%)			$159.50

determine when the additive effectiveness had been reduced to the extent that the oil quality could not be maintained and an oil change was required.

It is possible the rather severe loss in oxidation resistance would have been overlooked had not the engine conditions noted during the inspections so clearly indicated that something was wrong. It was possible for a trained observer to accurately estimate the mileage elapsed since an oil change by inspecting the engines, providing the engine had been cleaned at the time of the last oil change.

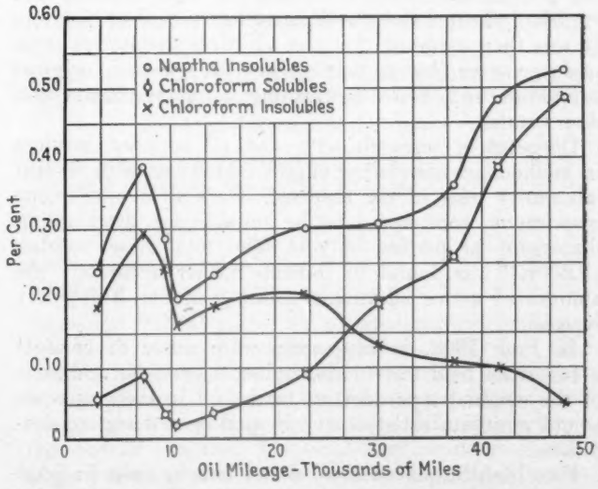
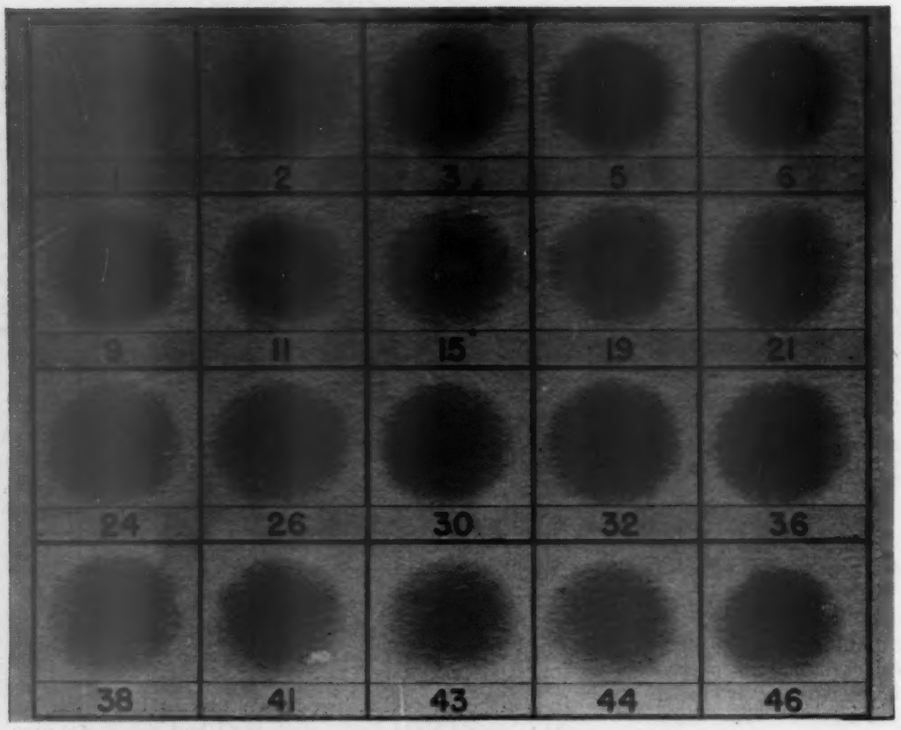


Fig. 2—Naptha insolubles, chloroform solubles and chloroform insoluble portions of naptha insolubles versus oil mileage. 1,500-hp. freight engine with heavy-duty oil

Due to the oil and engine conditions found, the oil in these high output engines was changed every 30,000 miles while an attempt was being made to determine the reason for the undesirable conditions encountered with extended oil mileages.

Even though analysis of the oil for additive metal indicated that a considerable portion of the additive



Blotter spot tests. 1,500-hp. freight engine with heavy-duty oil. (Oil mileage in thousands)

was still present in the oil during extended oil mileages, the performance of the oil and the conditions of the engines indicated that the additive had ceased to function. It was then assumed that the additives themselves must undergo some change causing them to lose their original properties and cease functioning as anti-oxidants and dispersants.

Cooperative research with one oil supplier resulted in methods of correlating engine conditions with several laboratory tests of the used oil. Dark field microscope inspections were found to be reliable for determining dispersant properties of oils. The total base number (TBN-E) was found to indicate rather accurately the amount of active additive remaining in one heavy-duty type oil.

In June 1948, arrangements were made to conduct a full scale field test to determine if periodic additions of the original type additive to the oil in the crankcase would maintain satisfactory oil quality and engine conditions.

Five high output railroad diesel freight units in good mechanical condition were selected. These units included two different engine builders' locomotives each powered with a 1,500 hp. diesel engine.

A full charge of 200 gal. of new lubricating oil and new lubricating oil filters were applied at the start of the test. Filters were changed as usual every 5,000 miles on one type engine and every 6,000 miles on the other. At each filter change 15 gal. of additive concentrate were added directly to the crankcase.

The additive concentrate consisted of the same base oil as used in the engine but contained five times the amount of additive contained in the new oil. By adding 15 gal. of concentrate, the same amount of additive was placed in the crankcase as was contained in 75 gal. of new oil. The tests on some of the units were interrupted on a few occasions by the need for oil changes due to excessive fuel or water in the oil. Other tests were interruped by oil changes made by maintenance forces, due to an oversight that the unit was on test.

However, several of the engines were operated with extended oil mileages including one run of 136,698 miles, another of 118,474 miles and another of 117,078 miles before the oil was drained. The oil in each instance was drained on account of work required on the engine or by error and not because of the oil quality.

Periodic inspection of these engines during the entire test have shown them to be satisfactorily clean. Sludge deposits and lacquer conditions have at all times been

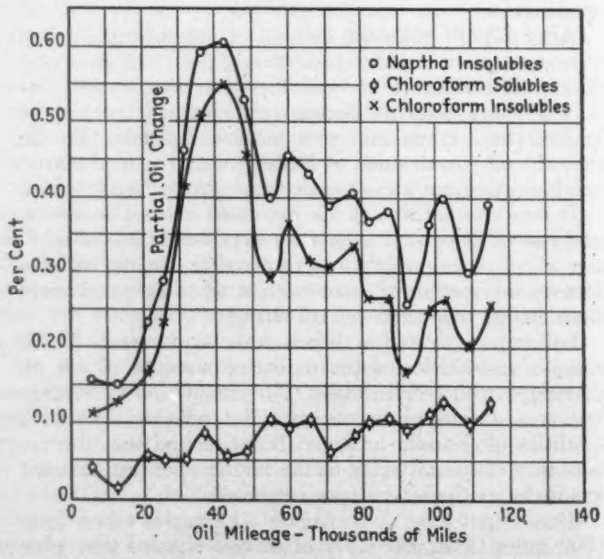
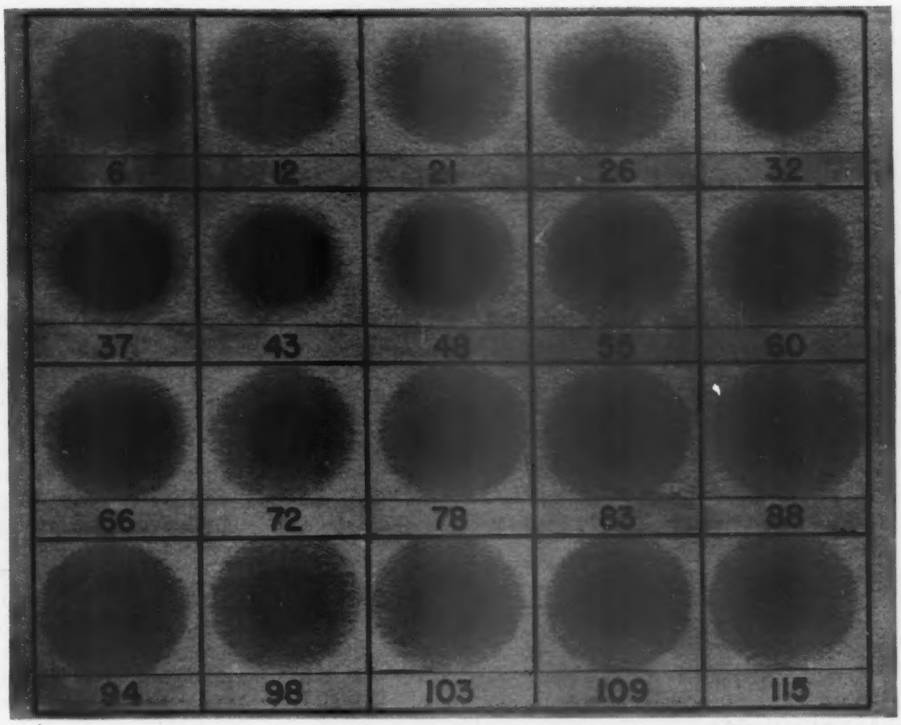


Fig. 3—Analyses of oil content versus mileage similar to that shown in Fig. 2. 1,500-hp. freight engine using heavy-duty oil with periodic fortification



Blotter spot tests of oil samples used for Fig. 3

comparable to conditions existing on engines operated on heavy-duty oil with low mileage oil changes.

Examination of the parts removed from these engines disclosed the pistons, rods, and bearings to be at least as clean as those removed from engines which were regularly oil changed every 30,000 miles and much cleaner than those run for extended mileages without additive additions.

Figure 3 is a graph showing the analyses for naptha insolubles, chloroform solubles and chloroform insolubles of periodic oil samples removed from the crankcase of one of the engines in the crankcase fortification test. The samples start at 6,000 miles and continue until oil was drained, by error, at 114,800 miles. There was a partial oil change on account of fuel dilution at 27,000 miles.

The naphtha insolubles, consisting almost entirely of chloroform insolubles increased rapidly for more than 40,000 miles, indicating very good dispersant qualities. The chloroform solubles, during this period, remained rather low, indicating good oxidation stability. Between 40,000 and 55,000 miles the naphtha insolubles and chloroform insolubles decreased at about the same rate. After 55,000 miles the naphtha insolubles and chloroform insolubles remained rather constant although there was a gradual decrease until the end of the test. During this period the chloroform solubles showed only a slight gradual increase indicating the oxidation stability was satisfactory during the entire test. At all times, during the life of the oil, the chloroform insoluble was considerably greater than the chloroform solubles. The amount of chloroform insolubles present at all times indicated that the oil maintained satisfactory dispersancy.

Blotter spot tests of the oil samples used in Fig. 3 indicate little chloroform insolubles and the spots show very small amount of black deposits. As the chloroform insolubles increased up to the spot at 43,000 miles the black portion of the spot becomes more dense. In both instances, when the chloroform insolubles dropped rapidly as indicated by the valleys in the graph at 55,000 miles and 94,000 miles, the oil spot shows considerably less black material than the previous spot. The oil remained less dispersant after 66,000 miles as indicated by the smaller diameter of the black portions of the spots. However, dispersancy was still satisfactory at the end of the test. The oxidation products increased slightly during the test as indicated by the change of the outer portion of the spot from yellow to light orange.

TABLE II—ADDITIVE ADDED TO CRANKCASE OIL 12 GAL. PER 1,000 MILE OIL CONSUMPTION; 90,000 MILES SERVICE

	Gal. additive
Regular Crankcase Fortification	
810 gal. make-up oil (3% additive)	24.3
270 gal. Fortification agent (15% additive)	40.5
Total additive added	64.8
High Additive Oil	
1,080 gal. make-up oil (6% additive)	64.8

It was found that the ash content of the periodic oil samples from the engines under test did not reach as high a percentage as expected. The ash content of the new oil used was 0.4 per cent.

The ash content gradually increased to 0.6 per cent or 0.7 per cent during the first 35,000 to 45,000 miles. From that time on until the end of the test the ash content fluctuated within narrow limits near this percentage. No actual explanation for this condition has been developed.

The results of the field test indicate that the percentage of additive metal in the crankcase oil is not indicative of the original additive remaining in the oil; that some reaction takes place with the additive in service which reduces its effectiveness; that high output diesel freight engines in heavy freight service can not be operated

satisfactorily for extended oil mileage with some of the heavy-duty oils available today. Previous experience indicated that they could not be operated satisfactorily with the straight mineral oils offered to the G. M. & O.; and that by periodic replacement of the additive in the crankcase oil, these engines can be operated satisfactorily for extended oil mileages with some heavy-duty oils.

Periodic additive addition which we call "crankshaft fortification" was started on a fleet of high output engines in freight service. Sufficient time has not elapsed since this project was started to be certain of the final results obtained.

It is more economical, based solely on the cost of new lubricating oil, to operate high output diesel engines for extended oil mileages with crankcase fortification than to change oil when the normal additive appears to become ineffective.

After complete dieselization of the railroad, it was found necessary to reclaim the crankcase drainings. Lubrication with fortification of the crankcase eliminates at least two oil drains per year per engine. The oil recovered from an oil drain averages about 175 gal. which indicates a reduction of 350 gal. of crankcase drainings per year per engine.

By lubricating the fleet of 50 high output freight engines with fortification of crankcases, we expect to reduce new lubricating oil costs approximately $8,000 a year and reduce the accumulation of crankcase drainings approximately 17,500 gal. per year.

If improved additives are not available it may be possible to secure extended oil mileages by increasing the amount of the additive contained in the new oil so that the total amount of additive supplied to the crankcase over a given period would be equal to the amount of additive supplied by the fortification procedure discussed.

To illustrate, let us use as an example one of the freight engines on test that requires 12 gallons make-up oil per 1,000 miles. The oil used contained, 3 per cent by volume, additive. Fifteen gallons of fortification agent containing 15 per cent additive was added every 5,000 miles.

Table II shows the total amount of additive in gallons added to the crankcase over a period of 90,000 miles by the above method which was used during the test. It also shows the amount of additive that would be added if an oil of the same type but containing twice the amount, or six per cent additive was used.

Inasmuch as make-up oil is usually added every 500 to 1,000 miles, the concentration of effective additive in the crankcase should remain more constant when high additive oil is used than when a large amount of additive is added at each 5,000 mile filter change.

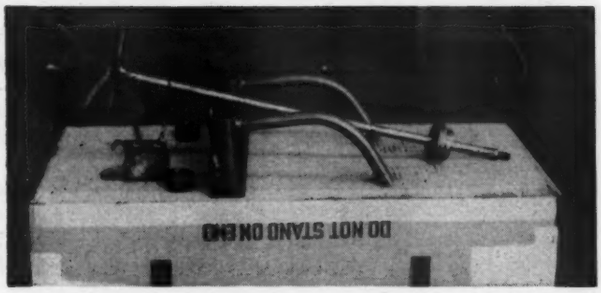
Therefore, high output diesel engines in heavy freight service probably could be satisfactorily lubricated for extended mileages with the present heavy-duty oils available if the additive content of the oils were increased. It is doubtful that the advantages of higher additive oils in high output railway diesel engines could be determined by the usual 100 hr. or 500 hr. laboratory engine tests. It is believed that these tests are comparable to no more than 25,000 to 30,000 miles of heavy freight service.

It is believed that the use of higher additive oil offers sufficient promise of being able to operate with extended oil mileages to permit a full scale field test to determine the results which could be obtained.

* * *

Rack used by the Southern's Spencer, N. C., shops to hold a complete assembly of liner, piston, head and liner gasket. A channel iron goes across the top and has three holes per head. Two are for eyebolts that hold the head and one for an eyebolt that supports the piston

Simplifying Diesel Work

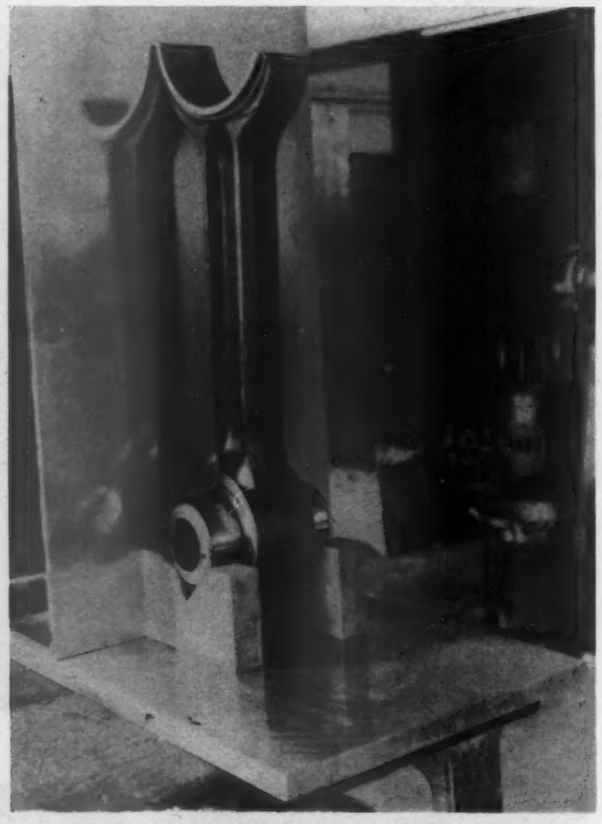


Above: A cylinder assembly used on the Chicago, Burlington and Quincy. Right: The lifting portion slips over two rocker arm studs and has a U-shaped rod for the crane hook. A T-bar with a washer and a taper pin prevents the piston from falling through and a wooden block for holding the rod central in the liner is attached to the T-rod by a chain.

Below, left: A lifting stand for steam generator coils used on the Wabash which is lowered into place and the legs moved out by a threaded rod and nut. The eyebolt is for the crane hook.

Below, right: A coil, also used on the Wabash, for cleaning 100-mesh screens of Nugent strainers. The strainer is slipped over the coil and steam blown through a series of 1/16-in. holes in the coil. The steam is for cleaning the strainers after steaming.

Connecting Rod and Wrist-Pin Checker



Arrangement used by the Wabash for checking both connecting rods and wrist pins

At the Decatur, Ill., shops of the Wabash a pair of perpendicular faced plates are used in conjunction with surface gauges to check wrist pins and connecting rods on Electro-Motive and Alco-G.E. equipment. The arrangement checks the rods for both twist and proper bearing-to-bearing dimension.

The wrist pins are checked resting in on a pair of V blocks. As the blocks and the two plates are both faced and ground, the wrist pin is parallel to both plates for accurate checking. The bottom plate extends a sufficient distance forward of the vertical plate and the blocks to permit easy maneuverability of the surface gauge and dial indicator used to check the wrist pin.

Rods are checked with the wrist pin in place in the rod and resting in the V blocks as it did above. An extension is used to mount the surface gauge and dial indicator for checking the crankshaft bearing end of the rod.

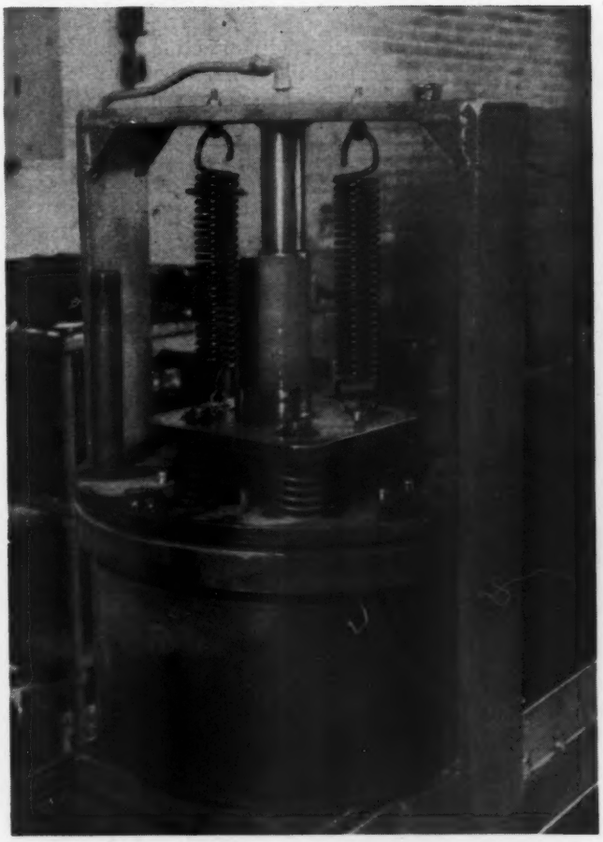
Assembly Line for Cylinder Heads

The Chicago, Burlington & Quincy has placed the reconditioning of diesel-engine cylinder heads on an assembly line basis at the West Burlington, Ia., shops. The heads arrive in the assembly line area dismantled, cleaned and faced on the liner seat. All of the subsequent operations are performed on the cylinder head assembly line.

Operations performed on the assembly line conveyor include finish cleaning, inspection, and buffing out the valve-guide holes and the liner stud holes. The latter operation is performed to prevent dirt from the threads being knocked off on the seat when the head is applied over the stud threads.

The remaining operations include water-pressure test-

Assembly line for reconditioning diesel cylinder heads. In the foreground is the hydraulic arrangement for applying the half collets; in the background, the grinding area equipped with a vacuum exhaust system located underneath the bench



The foot-controlled hydraulic-pump-operated spring depressor for applying the valve half collets

ing at 60 lb., grinding the valve seats, applying and kerosene testing the valves, chasing the studs, and applying the springs and half collets. The application of the springs and lock-spring seats is done on a special fixture, operated by a foot-controlled hydraulic jack, which compresses all four springs simultaneously for application of the half collets. The valve-grinding area is equipped with a vacuum exhaust system located under the bench on which the valve grinders are mounted.

Air Clamp For Injector Pop Tester

The time required for tightening and untightening the fuel connection stud nuts on Diesel engine injectors is eliminated by a pneumatic clamp attachment on the pop tester used at the Spencer, N. C., shops of the Southern. With the attachment, a block is pneumatically clamped on the filter cap to make a fuel-tight connection for checking the pressure at which the nozzle begins to spray.

The clamp is actuated by an air cylinder which is located in the work bench compartment and is 5½ in. in diameter with a 1-in. stroke. An extension shaft on the piston rod actuates a lever mounted horizontally with its fulcrum at the center. When this shaft is raised by the cylinder air pressure the block is lowered and clamped in place through the lever. The block mates with the fuel

Pneumatic clamp for checking nozzle spray pressure

openings in the filter cap and has a pipe connection to the pop tester fuel tank.

Stand to Grind Diesel-Engine Heads

Grinding valves on Diesel-engine heads is simplified by using a head stand of the type built at the Southern shops in Spencer, N. C. The stand is mounted on two 4-in. flues

Head stand for grinding valves

29 in. high and 11 in. apart which are threaded on top to receive two elbows. A third flue 19 in. long connected to the head clamp on one end pivots about a 3-in. shaft to load the head on the stand or to position it for grinding the valves.

A ratchet lock on the front elbow holds the head in a horizontal position for grinding any one of the valve seats. The head holder itself is in two semi-circular halves which pivot on hinges to clamp the head.

Each half has a varying cross section, thick near the flue for mounting purposes and thin on the opposite side to lessen the weight. The head rests on brass that fits in a shoulder in each half of the holder.

Connecting Rod Alignment Checking

Connecting rods are checked for twist and bearing center-to-center distance with a dial gauge mounted on a holding fixture at the Chicago & North Western Kinzie

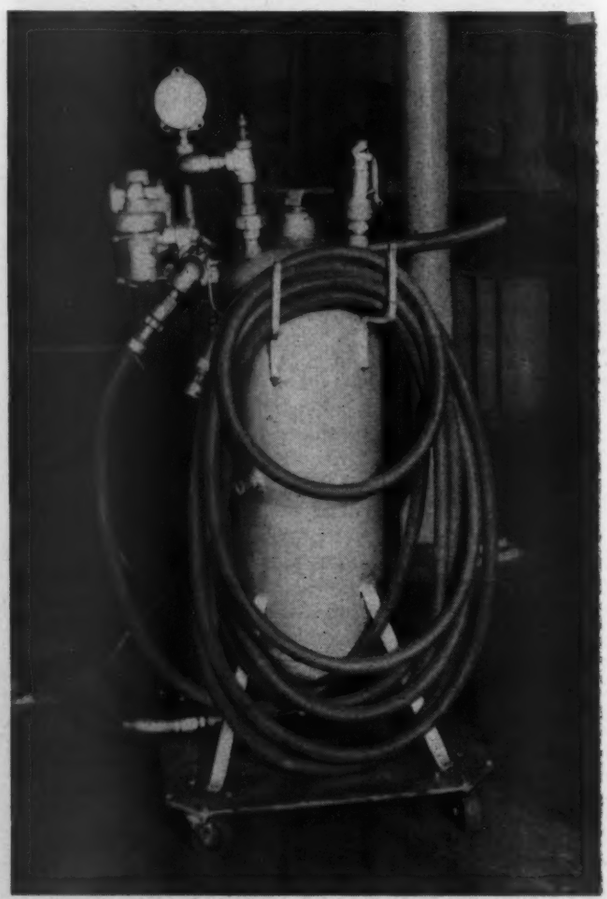
A dial gage mounted on this holding fixture checks connecting rods for both twist and bearing center-to-center distance.

street shops in Chicago. The main bearing end of the rod fits over a piece of half-round stock with a radius equal to that of the rod bearing, and the body of the rod is held in an upright position by set screws mounted in a bracket a little above the center of the rod.

A dial gauge is mounted on a shaft which has a common center line with the wrist pin bearing of the rod. The shaft is free to move in and out, and to turn. Moving the gauge in and out checks the rod for twist, while turning it checks the bearing center-to-center distance of the rod.

Buggy To Fill Traction Motor Support Bearings

The Wabash has built, at its Decatur, Ill., shops, an easily movable buggy for filling the traction-motor support bearings on Alco-G.E. locomotives. The buggy holds 15 gal. of oil which is delivered to the support bearings by air pressure furnished from the shop air



Buggy for filling traction-motor support bearings on Alco-G. E. locomotives

system through a reducing valve set at 45 p.s.i. The tank is equipped with a safety valve set at 50 p.s.i.

The oil is delivered to the support bearing until the gauge on the nozzle starts to rise, which shows that the support bearing is full. Flexibility is attained by equipping the buggy with 50 ft. of air hose and 12 ft. of oil hose. Damage to the nozzle is avoided by covering it with a rubber sleeve.

New Railway Car–Building and Repair–Shop Methods*

By C. R. Strutz†

RAILROADS can make important savings by taking advantage of improved modern methods, both as to new construction and repairs, thus reducing shop costs. One way of cashing in on the construction and repair savings, I believe, is closer cooperation between railway mechanical engineers and car manufacturers for new construction, and welding engineers for repair work in railroad shops.

For instance, in the case of new construction, railway mechanical engineers are responsible for the design of passenger and freight cars. With but few exceptions, every order of cars is tailor-made to suit the purchaser even though these cars may be used on other railroads a greater part of the time than on the owning line. Because one designer believes that a washroom should be in one corner of the passenger car and another designer thinks it should be in the opposite corner, the car structure must be largely built to order.

The A.A.R. has finally adopted a standard design for a welded box car. Two car builders are specializing in producing standard designs and, in that way, pass on the savings realized to railroad customers. In these new ideas, welding plays a dominant part. Yet it is apparent that much more research is necessary in stress analysis, etc., to overcome some of the failures that have developed. The car manufacturers are prepared to move forward and will overcome these difficulties.

In numerous instances, the advantages of welding have not been fully utilized at the time repair programs are still in the talking and design stage. Often, material is ordered and the program started before the welding advantage is noted resulting in inability to realize the total savings possible in material and labor. If some arrangements can be worked out whereby the welding engineer's know-how can be applied and combined with the railway engineer's knowledge before the details of the program are settled, marked improvement and economies will be realized by the railroad.

Unfortunately, some of the welded car designs are simply riveted designs changed to substitute welds for the rivets, often at the discretion of the shop. This may have been necessary in the past because of the ever-increasing orders and shortage of skilled and trained personnel.

The need of design changes on such short notice did not permit adequate studies to be made with the result that many of the advantages available from modern welding practice and equipment were not fully realized. This requires the utmost cooperation between the engineering departments and the shop.

The various welding processes have played an important part in the production and repair of railroad equip-

Fig. 1—Portable Unionmelt hand-welding unit and jig used in fabricating bolsters

* Abstract of a paper presented at the November 6 meeting of the Northwest Carmen's Association, St. Paul, Minn.

† Oxweld Railroad Service Division, Union Carbide and Carbon Corp.

Fig. 2—Details of the freight-car bolster welding fixture

ment. There is always a need for more efficient welding which will extend the economical service life of car and locomotive equipment. Since railroads must continue as successful enterprises they should adopt and use these more efficient welding methods as a means to the better utilization of manpower and material.

The more recently developed streamlined, high speed rolling stock is the result of extensive research, designed to take advantage of any and all metals and alloys that have inherent physical properties most able to meet a definite service requirements. Many of the welding processes and procedures were adequate for the older type equipment but as newer types displace the older it is found that the quality requirements of welding place several of the older processes and procedures in a secondary position.

Typical Examples of Savings

The accompanying illustrations show some of the developments that have resulted in substantial savings to the railroads in material, labor and increased production.

The majority of Unionmelt welding applications on railroad equipment are best done with the automatic welding process, however, in some cases, the portable hand tool which is the latest development can be used to good advantage. With the automatic method of welding the head is moved across the seam by some mechanical means. With the hand welder the nozzle is moved along the seam manually. This type of unit makes it possible to do miscellaneous jobs, such as repairs on joints normally inaccessible for automatic welding. The speed of operation with the flexible welder is much greater than by other kinds of manual welding.

In Fig. 1 a general view of one of the flexible welders in operation is shown. Here the unit is mounted on an elevated table for easy positioning and the 20-ft. welding tube is partially supported with a flexible arm. This particular installation made it possible for a railroad shop to weld enough bolsters, crossbearers and center plates for

Fig. 3 (above)—Type of jig used in fabricating crossbearers

Fig. 4—Special jig which facilitates making center plates at low unit cost

Fig. 5a—Rebuilt pulp wood car

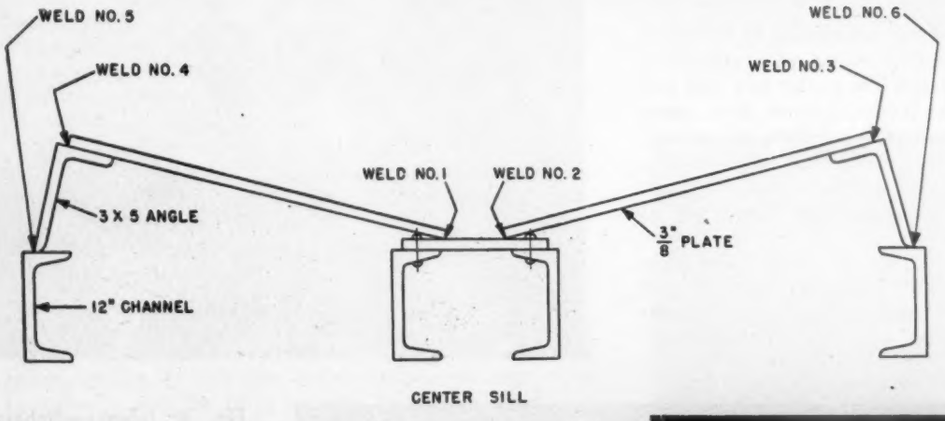


Fig. 5b—Unionmelt portable automatic equipment used in making welds at locations as shown in the diagram

Fig. 6 (below)—Aluminum lounge-chair frames being fabricated by Heliarc welding

a daily production of five cars. The welding unit was operated for three shifts a day using a welding operator and a helper. In this program several interesting fixtures were used.

In fabricating bolsters, the top and bottom cover plates and web plates are tack-welded together and then removed and placed in a fixture, the details of which are shown in Fig. 2. This fixture is quite interesting inasmuch as it has expandable copper back-up bars which are forced into the corners of the bolster. The fixture can be positioned in several different ways for downhand welding with the flexible welder. Bolsters with 5/16-in. web plates and 3/8-in. top and bottom plates were welded with 550 amp. of welding current at a speed of 22 to 26 in. per min. using 1/8-in. welding rod.

On this same car program, the crossbearers were welded in much the same manner on a jig shown in Fig. 3. All of these fixtures were made in the railroad shop at little expense and proved successful in every way. The welding of the center plates in the aforementioned program of five cars a day is shown in Fig. 4.

One operator and two helpers were able to weld 20 crossbearers and 20 center plates in eight hours. When

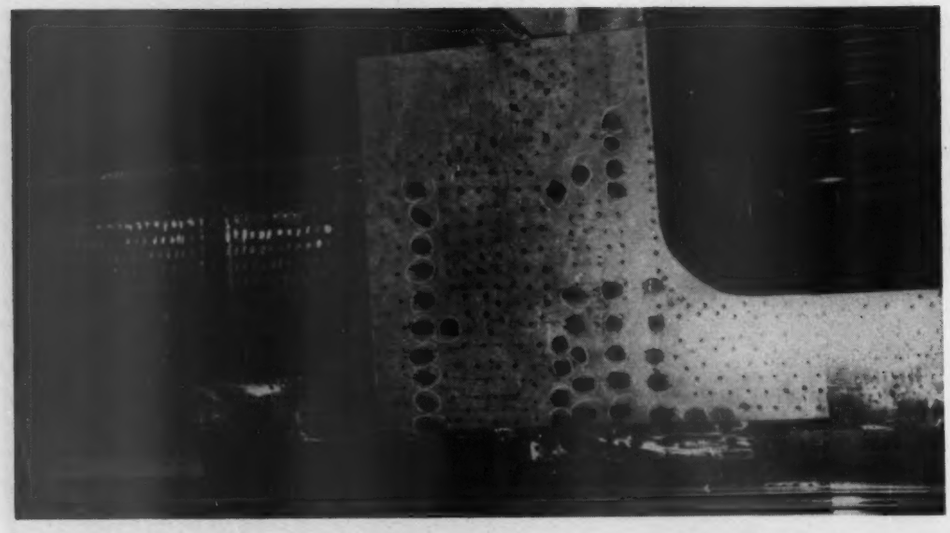


Fig. 7—How reinforcing sheet is applied to strengthen stainless-steel car-side member

welding bolsters alone, one operator and one helper produced 22 bolsters in eight hours. One flexible welding unit was able to produce 20 bolsters, 20 crossbearers, 40 cross ties and 10 center plates for the five-car-per-day production in a 24-hr. period using, in each case, one operator and one helper.

An interesting example of car rebuilding is shown in Fig. 5. In this program new floor sheets were applied to cars used for pulp wood service. The center sills, old and corroded, were flame cleaned before the new floor sheets were installed. The entire assembly of floor sheets and side angles was fitted and tack-welded and then Unionmelt welded with an automatic machine. The portable automatic welding machine was guided by a track placed directly on the floor sheet.

The welds at the center sill, Nos. 1 and 2, were made at 600 amp. at a speed of 16 to 18 in. per min.; Nos. 3 and 4 between the floor sheet and the side angles at 650 amp. at 32 in. per min.; and welds Nos. 5 and 6 be-

Fig. 8 (above)—Heliarc weld used in making repairs to a stainless steel car roof

Fig. 9—Welding the longitudinal seam on a 1⅛-in. thick aluminum tank-car tank using an Argon metal arc-welding machine

Fig. 10—Welding aluminum anchors to an aluminum car tank with an Argon metal arc-welding hand unit

tween the side angle and the side sill at 550 amp. at a speed of 16 to 20 in. per min.

Heliarc welding is being applied with ever-increasing frequency to car work. In Fig. 6 vanity chairs and lounge chairs for passenger cars are being fabricated. The framework of these chairs is made of ¾-in. square aluminum tubing. This view shows an operator welding the frames of the chairs, each weld requiring two minutes. Welding currents of 150 to 175 amp. are used with an argon flow of 10 liters per min.

Figure 7 shows how the process can be applied to reinforce steel members. This view shows the side of a stainless steel passenger car where ordinary spot welds could not be used. Holes were drilled through the sheet and Heliarc welding was used to weld the sheet to heavy support members through the holes.

Heliarc welding is successfully used in making stainless steel passenger-car repairs to such parts as the roof shown in Fig. 8. The operator is making an edge weld in order to seal the joint between the channeled center section and the corrugated section. This had previously ben spot-welded and soldered. Leaks developed due to vibration and it was successfully repaired with Heliarc welding. In making this repair the joint was heated with an oxy-acetylene blowpipe to eliminate the solder and the channel was filled with wet asbestos to prevent distortion. No welding rod was used in this application.

The Chicago, Burlington & Quincy has been reconditioning some of its old style suburban coaches and has utilized Heliarc welding to advantage. One particular application is the welding of roof sheets to new carlines. The old cars were of the double-deck roof type and are being converted to the turtle-back type. The carlines were made of 1½-in. angles and the roof sheets are ⅛-in. open-hearth mild steel. Sheets are spaced ⅛ in. apart and the weld is made with 3/32-in. Cromansil rod at 140 amp. of d.c. current. There are 27 roof seams per car, each 13 ft. 6 in. long. The particular advantage in this case is the great saving to be realized in the elimination of almost all of the grinding necessary to smooth down the joint. With the ordinary open arc electric welding the grinding costs were quite extensive requiring the removal of considerably more metal and spatter.

In the process of Heliarc welding, the arc generating the welding heat is formed between a tungsten electrode and the work. The welding rod is normally added manually and the weld zone is protected by a blanket of inert gas, usually argon. Recently a new method of welding, known as Argon metal-arc-welding has been developed. This process uses argon gas for a shielding medium and is used for Heliarc welding but the welding heat is generated between a consumable electrode and the work. In this regard it is similar to Unionmelt welding inasmuch as an electric rod feed motor is used to feed rod from a coil into the welding zone.

In Fig. 9 an Argon metal arc-welding machine is shown welding a longitudinal seam for an aluminum tank car. The tank is made of 1⅛ in. thick aluminum and is successfully welded at speeds substantially greater than was possible by manual Heliarc welding. All these welds are completely X-rayed and fully meet the rigid specifications imposed. The use of these machines has resulted in a substantial increase in the productive capacity of this car fabricating plant. Another application of Argon metal arc-welding by means of a hand unit is shown in Fig. 10. In this view an operator is welding aluminum anchors to a car tank.

The future of welding on railroads and benefits to be derived therefrom are dependent on the cooperation of railroad engineering and shop forces and the welding industry. A tremendous saving in dollars and man hours may be realized from the use of welding which will assist the railroads in maintaining a strong financial position and also enable them to render better service.

★ ★ ★

Fixture for holding the service portion of air-brake valves at the Bloomington, Ill., shops of the Gulf, Mobile & Ohio. The fixture pivots about either the vertical or the horizontal axis and secures he service portion with only one clamp. A similar fixture is used for the emergency portion. Both are made from scrap ¼-in. plate and angle iron

Beveling Circular Plates

The apparatus for bevel-cutting a circular plate. The motor has an infinitely variable speed control to give surface cutting speeds from zero to 32 in. per min.

Bevels of any angle may be torch cut with a device developed at the Bloomington, Ill., shops of the Gulf, Mobile & Ohio. The device, attached to a conventional shape-cutting machine, was formerly used for flame hardening.

The first step in cutting a beveled circular plate is to cut out the circle with straight walls

In cutting the bevel segments from the outer ring are cut off about six times with a hand torch and removed with tongs to prevent heavy sections falling and damaging the turning mechanism

It consists of a revolving table, worm-gear-driven by a ⅛-hp. rheostat-controlled variable-speed motor, and an adjustable torch mounting marked off in degrees.

The first step in beveling a circular plate is to turn the plate round with straight walls. During this process the segments beyond the circle are burned off about six times to prevent the falling of heavy pieces which would jar the drive and throw the mechanism out of line. The segments are removed with tongs. If large sections are to be beveled the plate is pre-heated up to 700 deg. F.

After the plate has been cut with straight walls a small groove is burned by hand to where the torch will start when set at the bevel angle. The motor is then switched on to revolve the plate and cut it to the desired bevel. The bevel may be made either for the entire thickness of the plate or for a partial thickness, leaving a straight section above or below the bevel. Two different bevels may also be made on the same plate. A bevel may also be placed on the section hollowed out. In this case the starting groove is hand cut from the inside out.

The finished beveled circular plate. If desired, concave bevel can be cut on a continuous-surface ring by slightly altering the procedure

Box-Car Laundry Track

The portable tank from which the box-car cleaning compound is delivered to the nozzle. The steam and water lines which feed this tank are on the right

A car after cleaning on the Southern's box-car laundry

The Southern has completed a laundry track installation at Spencer, N. C., with which five men thoroughly clean an average of 40 or more box cars a day. The laundry track is part of the running repair track for easy switching, and is long enough to hold 20 cars at one spotting. It is laid on a level grade with one rail 2 in. lower than the other for draining the cleaning solution from the interior of the car out through the door opening.

The cars are cleaned after inspection and necessary repairs have been given. Twenty are spotted at one time

The car is cleaned with an injector nozzle on a 7-ft. handle to get in all the corners

with a switching locomotive and left coupled together during the cleaning operations and subsequent switching.

An air line of 1¼-in. pipe is mounted on the ends of the ties along one side of the track for blowing out loose dirt and refuse. The water and steam lines are 1¼ in. in diameter and are supported 6 ft. above the ground on 3-in. pipes. Both are made of welded 2-in. scrap flues. The air line carries 80-lb. pressure and the steam line 125-lb. pressure.

Steam is generated by a diesel locomotive steam generator, which was chosen for this service because it kicks off automatically when not in use, requires no attendant and has no standby fuel loss. The steam generator delivers its output into a reservoir drum at 150 p.s.i. The outlet of this drum has a regulator set at 125 p.s.i. This arrangement delivers a constant flow of steam at a constant pressure.

Cleaning is done with a mixture of Pennsalt 45 X, using six ounces per gallon of water. To this is added a mixture of 2½ lb. of Orvis paste for each 50 gal. of water. The compounds are mixed in a 300-gal. main storage tank. The resulting mixture is delivered to portable two-wheel rubber-tired service tanks that move on a concrete runway on the low side of the track. The cleaning compound is dispensed to the car through a 1¼-in. Sellers injector connected to the exit end of the hose that leads out from the tank.

The handle which contains the nozzle is 7 ft. long to permit the workmen to get in all corners of the car. Rubber connection hoses are 1½ in. for the water and 1-in. for the steam. Cars which require deodorizing after cleaning are hand sprayed with Oakite Transamite.

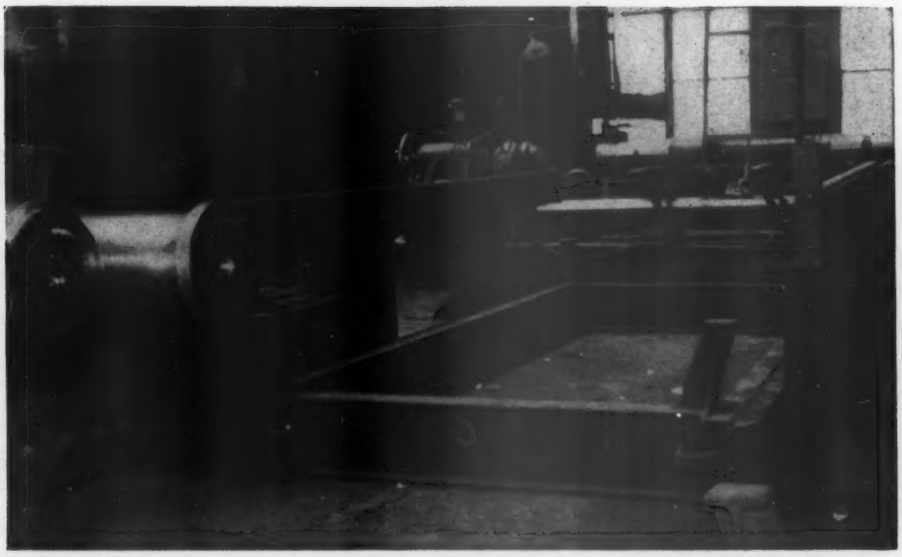
Handling Axles During Reconditioning

The Battle Creek, Mich., shops of the Grand Trunk Western has incorporated several useful material-handling devices in the axle-reconditioning production line. After the wheels have been pressed off, the axle is placed on a rack from which it is fed to the lathe by a jib crane. Leaving the lathe the axle is placed upon a ramp which is equipped with a transfer mechanism at the discharge end.

The transfer mechanism comprises a pair of arms that pivot between a horizontal and a vertical position. In the vertical position the arms serve to hold the axles on the feeder rack in place. In the horizontal position the arms serve as extensions of the rails of the rack. Lowering to the horizontal position is done by an air cylinder, which operation automatically transfers one axle from the rack to the extension arms. From the extension arms the axle rolls onto a pair of fixed rails on the burnishing machine.

The portable racks hold up to 16 axles and can be stacked up to eight high

The transfer mechanism for loading axles on the burnishing machine. The axle is loaded on the burnishing machine rack by a pair of pivoting arms from the ramp in the background and is raised to position for engaging the machine centers by the small air jack



The portable rack for handling and storing axles. With the axles resting on the permanent rack, a chain suspended from a crane is hooked to the four corners of the portable rack. As the portable rack is lifted it engages the bottom surfaces of the axles and holds them securely in place by the corner bosses

These rails place the axle a little below the centers of the burnishing machine. The axle is raised for engagement with the centers by a small air jack located between the two rails.

When burnishing is completed the axle rolls off the burnishing-machine rails onto a permanent rack that holds 16 axles. The axles are removed from the permanent rack for storage with a portable rack that holds the same number of axles as the permanent rack. The portable rack serves two purposes. It fits between the rails of the permanent rack and loads the axles onto itself automatically by contacting the bottom edges of the axles as it is raised by the crane through the rails of the permanent rack on which the axles are resting. The chain of the crane hooks to special brackets on the outside of the portable rack to permit picking the axles up as it is being raised.

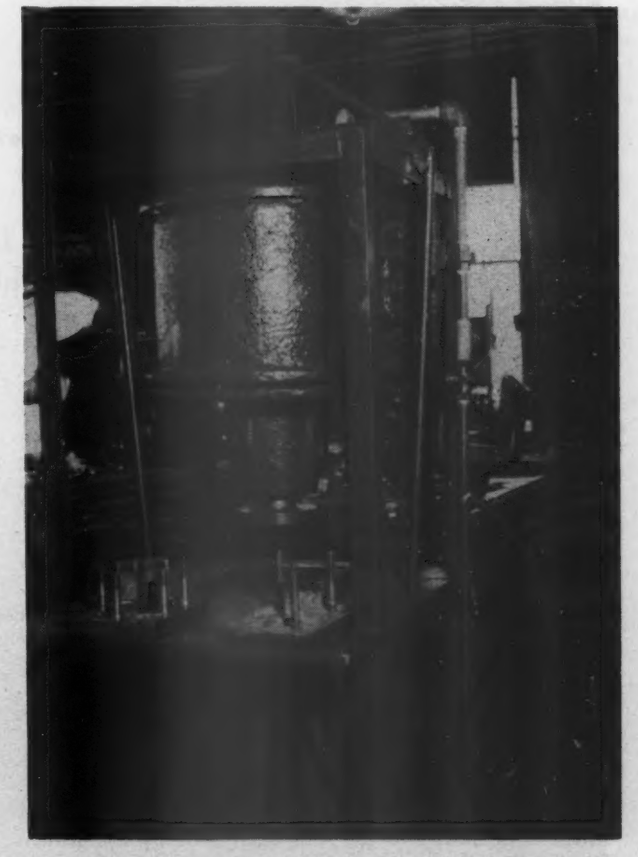
The second function of the portable rack is to store a sizable number of axles in a small space, for which purpose bosses are welded on the four corners. The bosses permit stacking the racks, either empty or loaded, up to eight high with a shop crane, until the axles are called for by the wheel shop.

Extra-Safe Air Brake Cover Press

A cover straightening press for air brake valves has been built at the Bloomington, Ill. shops of the Gulf, Mobile & Ohio in which the possibilities of injury are virtually eliminated. This is accomplished by locating the two valves which are necessary for operating the press along one side so that both hands must be used to operate the press. In this way a man's fingers must be out of the way during the down stroke.

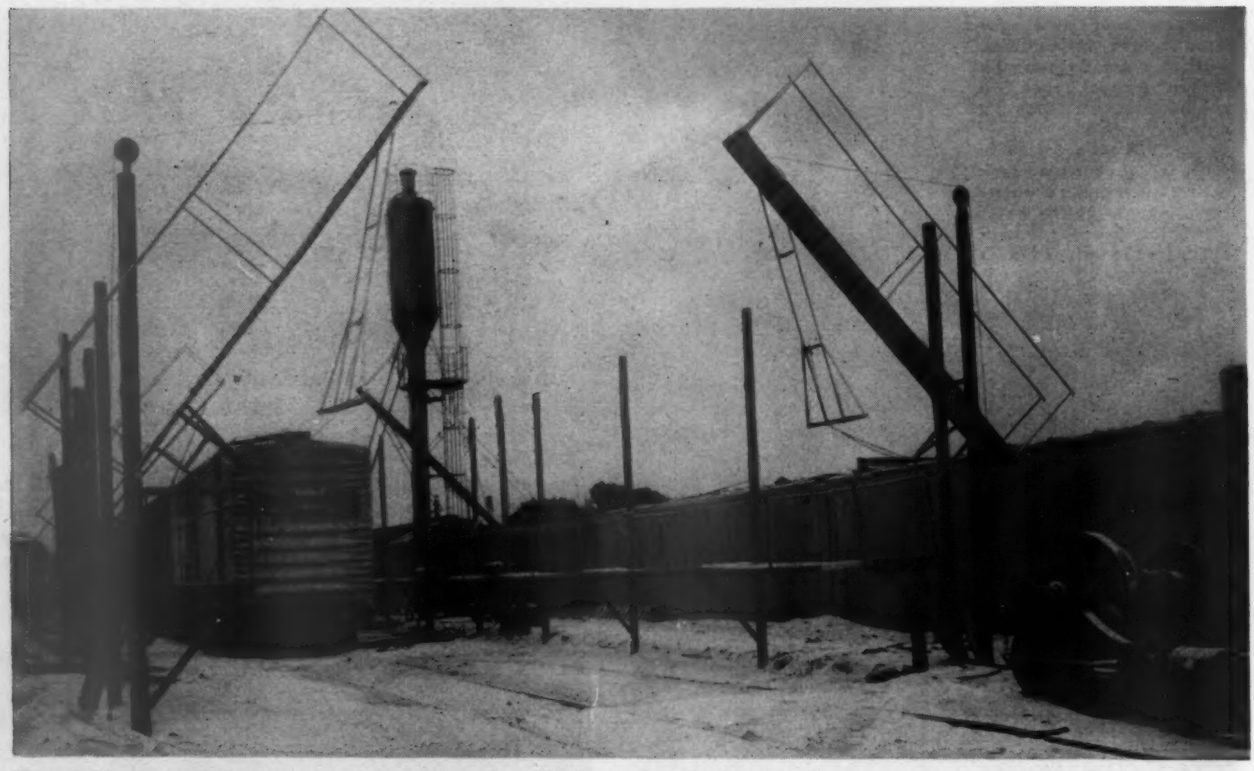
A second modification to the usual type of press for this type of work permits shortening the table. A tension rod ¾ in. in diameter over the top center of the cylinder permits shortening the table by eliminating the need for any struts.

The straightening press is a shop-made device in which the member providing the pressure is a 14-in. by 12-in. air cylinder mounted in a structural steel frame built of angles welded at the corners. The bed of the press is a 1⅛-in. steel plate and mounted on the bed are positioners for locating the air brake valve covers.



Air brake valve cover straightening press has the two valves necessary for operation located on the right side near the back so that the workman must have both hands clear during operation—The tension rod across the top center of the cylinder permits shortening the table by eliminating the need for struts

Layout for Sand-Blasting Cars



The sandblasting area from the exit end with the end scaffolding in the raised position for movement of cars by the winch at the right

A description of the shop facilities used by the Southern at Spencer, N. C., for sandblasting preparatory to painting

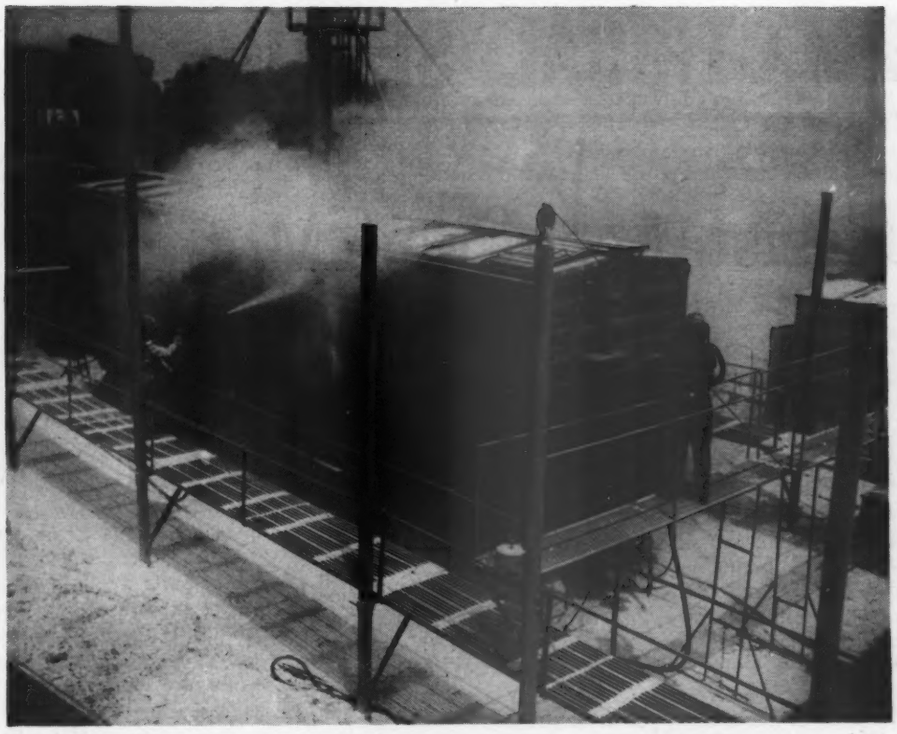
THE area for sandblasting freight cars at the Spencer, N. C., shops of the Southern has one section for cleaning the lower half of the car completely free from obstruction and a second equipped with scaffolding for sandblasting the upper half of the cars. The sandblasting area proper holds four cars, two in the area for the bottom half and two in the area for the top half. The scaffolding for the top half extends for 100 ft. so that with two cars in the area there is sufficient space for cleaning all four ends. The service track, which holds eight cars, is on a 0.6 per cent descending grade to feed the cleaning area. The inclined track extends through the area for sandblasting lower half of the cars and into the scaffolded area. A concrete platform 10 ft. wide is laid along the sandblasting area for a distance of 210 ft.

The cars are rolled into the sandblasting area and spotted by a winch at the exit end. The bottom half of the car is cleaned first in the unobstructed area, after which it is moved to the scaflolded area by the winch for cleaning the top half. Two types of scaffolding are installed to handle the sides and the ends.

The side platforms are 36 in. wide, 4½ ft. above the ground, and are located 5½ ft. from the edge of the car. They are made of lattice wood with sections ⅞ in. by 2½ in. joined by bolts. Guard rails of ¾-in. pipe are mounted 3 ft. above the platforms. Supports for the guard rail are strap iron sections ⅝ in. by 2 in. which bolt to the bottoms of the platfroms.

The three end platforms swing in a vertical arc to permit the passage of cars into and out of the area. These platforms are chained in the clear position for safety and are counterbalanced for easy movement by a weight on a pulley. When in working position they are 7½ ft. above the ground. Construction is of box car running board material stiffened by angle iron ¼ in. by 1½ in. running lengthwise. The guard rails and the guard rail supports are ¾-in. pipe, with the rails 3 ft. above the platforms. The supports on which the ends of the end platforms rest when in working position are hinged to the platforms. They are built up from sections of ¾-in. pipe joined together along the bottom by angle iron members ¼ in. by 1¼ in. by 48 in. which are used to provide additional bracing for the supports.

Uprights for the scaffolding are 5-in. flues. Eight are used for each side platform and two for each of the three end platforms.



The top half of both the sides and ends of the cars are sand-blasted easily and safely from the scaffolding

Sand is stored in a 10-cu. yd. tank at ground level, from which it is delivered by air pressure into a second 10-cu. yd. tank 30 ft. above the ground. It flows by gravity to four service tanks, each of which hold 1¼ cu. yd. Sandblasting is done with a 1-in. hose at 100 to 110 p.s.i. pressure with both the air and the sand in the same hose between the 1¼-cu. yd. tank and the delivery nozzle. One air control is installed for each two sandblast nozzles.

For added comfort to the workman a pressure-reducing valve has been installed which cuts the air pressure to 4 p.s.i. for ventilating the helmet. During hot weather this ventilating air is cooled by being passed through an ice box containing 100 lb. of ice.

The end scaffolding showing the hinged supports and the counterweight

ELECTRICAL SECTION

Resistance-Lead Motors For A.C. Multiple-Unit Cars*

By H. G. Jungk†

A NEW m.u. car motor, designed and built for the Pennsylvania electrification, is the Type 431-A, single-phase, series motor with a shunted interpole, no compensating winding and with resistance leads in the armature winding. This motor has a continuous rating of 225 hp. at 328 volts, and 760 amp. at 1,270 r.p.m. The top sustained running speed is 2,800 r.p.m. The corresponding car speeds are 41.3 and 91.1 m.p.h., respectively, with 36-in. wheels and a $^{17}/_{56}$-2 d.p. gear ratio. The average accelerating tractive force of the car (two motors) is 7,000 lb. at 1,050 amp. per armature.

This armature has 8 poles and 8 brushholders, with 3 brushes each of $^{3}/_{8}$-in. x $2^{3}/_{8}$-in. x $2^{1}/_{2}$ in. long electrographitic carbon. The ventilating air enters the air-intake at the rear or pinion end of the frame and is forced through 3 parallel paths to the front or commutator end where all of the air is baffled to pass down over the commutator and brushholders and out through the front housing.

These new motors are smaller than the 412-D and 426-AA types now in operation on Pennsylvania m.u. cars, and have smaller pinions and gear center distance but the frames are designed to fit in the same trucks with the same size axle bearings and the same nose-suspension details as on the present cars. As a result, the frames, housings, axle bearings, axle caps and other stator parts weigh about as much as on the corresponding 426-A motors with fabricated frames, but less than those of the 412-D motors with cast steel frames. The armatures, operating at twice the speed of the 412-D armatures, are much lighter.

Comparison of Motor Weights

Type	412-D	426-A	431-A
Weight, lb.:			
Motor complete with gear case, axle bearings and axle caps ..	6,490	5,938	5,344
Pinion	135	116	61
Total	6,625	6,054	5,405
Armature	2,350	2,230	1,615

The 431-A motors are geared to give the same starting and accelerating tractive forces per car as the 412-D motors, but will operate up to 90 m.p.h. as a sustained running speed while the 412-D's are limited to 70 m.p.h. and the 426-A's to 80 m.p.h. top speed. Although intended for the lighter MP-54 cars, the 431-A motors

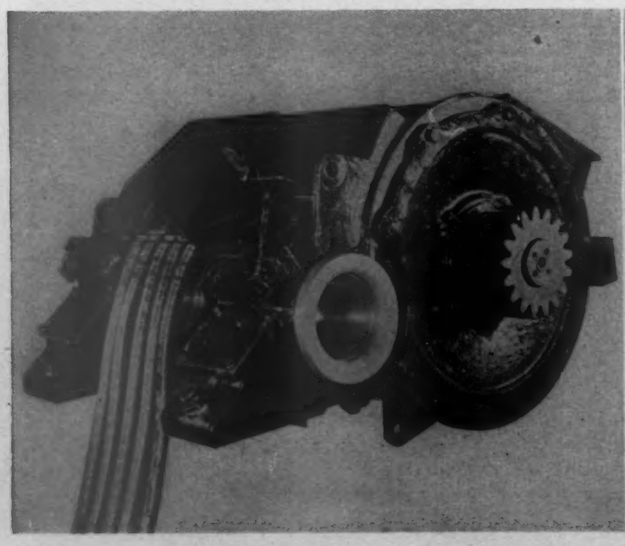


Fig. 1 (left)—Pinion end of Type 431-A motor. Fig. 2 (right)—The commutator end of same motor

* Abstract of a paper presented at the Winter General Meeting of the American Institute of Electrical Engineers, held in New York, January 22-26, 1951.

† Section Head, A.C. Railway Motors, Transportation and Generator Engineering Department, Westinghouse Electric Corporation, East Pittsburgh, Pa.

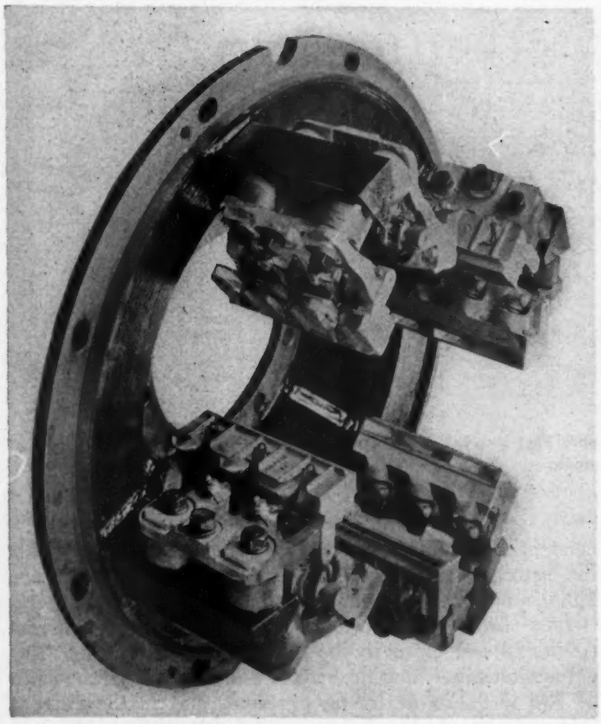


Fig. 3—The commutator end housing of a Type 431-A motor, complete with brushholder supports and brushholders

have the capacity to accelerate the heavier P-70 cars if applied on them.

The two motors on a car are connected in parallel to the transformer rather than in series as is generally done on both a.c. and d.c. motors. This minimizes the tendencies of wheels to spin when a wheel slip occurs.

After a careful study of the experiences over the past 40 years with a.c. multiple-unit car motors of various combinations of resistance leads, interpole fields, compensating windings on doubly-fed, repulsion and series types with high, low and medium flux per pole, the Type 431-A motor was designd with series fields and interpoles in the stator and resistance leads in the armature to give simplicity in both motor and control. The mechanical and electrical parts are substantially built and with sufficient margin in rating to insure low maintenance cost.

A number of features, incorporated in the design to eliminate some of the troubles experienced in the past, and to simplify maintenance, are applicable to any motor while others are possible only with the resistance-lead design.

General Improvements

The features adaptable to any design and their importance in reduced cost and maintenance are briefly as follows:

Rear End Ventilation—Many of the insulation failures on commutator motors are developed by introducing ventilating air at the commutator end. Overheating of front end ventilated 426 motors has been caused by improperly fitted commutator covers and resultant air leakage. On the 431-A motor, ventilating air is introduced at the rear or pinion end, so that carbon dust from brush wear is blown out of the motor, instead of into the windings. This materially reduces the possibility of accumulation of dirt on exposed creepage surfaces. It also has the advantage that if the commutator covers do not fit tightly, or if they fall open or drop off, ventilation will not be affected.

Pre-Insulated Armature Coils—To reduce grounds and shorts which now occur with the threaded-in-fold-over straps used on the more recent motors, open armature slots are used so that the coils may be pre-insulated and baked before winding into the slots. The coils are still constructed from two half-coils connected at both ends after winding so as to retain the advantages of winding and ease of repairing such windings.

Pre-Insulated Stator Coils—To improve the insulation of stator coils, and to reduce coil lead breaking, the exciting field coils are formed, pre-insulated and baked before winding into open slots. The coils are connected, all in series, to carry full line current and thus the conductors are of substantial cross section and strength. The interpole coils, like those on d.c. motors, are completely wound, insulated and baked before winding over the interpole, making the construction simple and rugged.

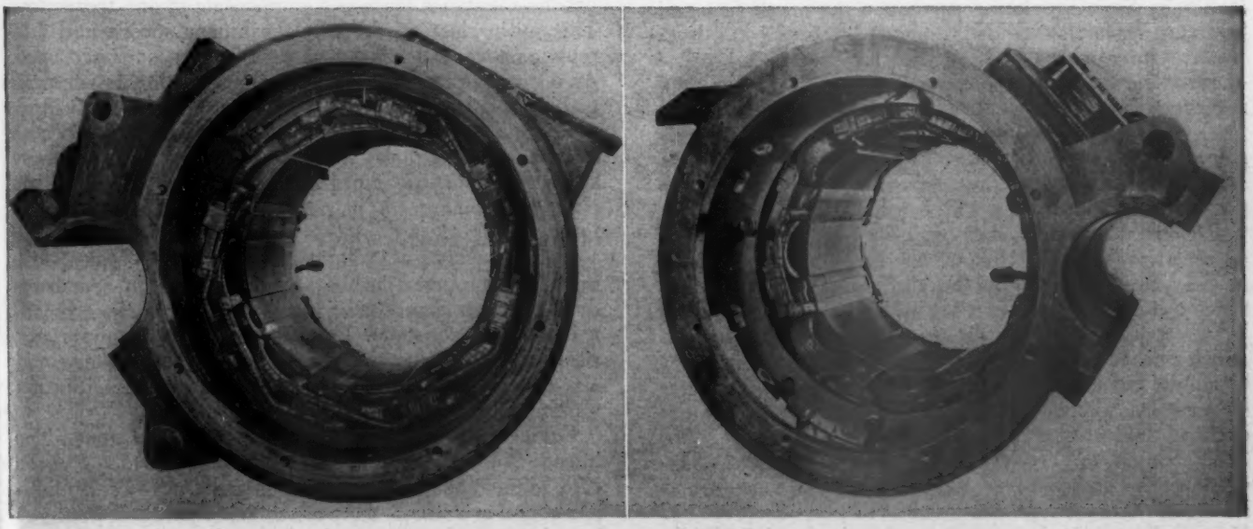


Fig. 4 (left)—The wound stator of a Type 431-A motor as seen from the pinion end. Fig. 5 (right)—Wound stator of the same motor as seen from the commutator end

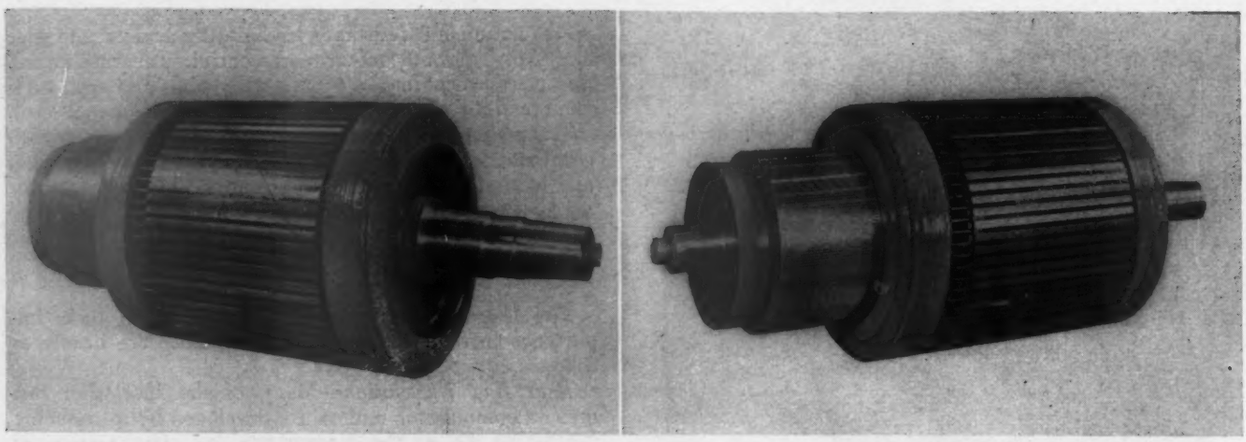


Fig. 6 (left)—The pinion end of the armature of a Type 431-A motor. Fig. 7 (right)—The commutator end of the armature of the same motor

Brushholder Support — Commutator motors usually have brushholders mounted in the frame and any repairs, replacements or neutral adjustment tie up a complete motor. The 431-A motor brushholder supporting arms are mounted on the housing thus providing for quick removal and replacement in case of trouble. This unit of housing and supports with brushholders can be repaired at the bench and location of holders checked and held on neutral.

Resistance-Lead Design Developments

The features applicable only to a resistance-lead design and their importance in reduced cost and maintenance are as follows:

Less Commutator Heating—Overheating of commutators, with resulting flat spots causing high commutator maintenance and brush breakage, has been one of the most elusive troubles with the commutator type motors in locomotive service. The resistance lead design reduces commutator heating. The resistance leads carry current only when the corresponding commutator bars are under a brush. Since this occurs in any one lead only 10 per cent to 12 per cent of the time, the resistance of the lead can be made high enough to substaintially limit circulating current in the brush face and armature circuit at standstill, and at low speed and high tractive force where the interpole has no effect because of zero or very low speed. Since the total brush loss and resistance loss in the windings is practically the same per hp., regardless of poles and windings, part of this commutation loss can be absorbed in the resistance leads around the armature, thus relieving local heating on the commutator surface and brushes.

Higher Flux per Pole at Start—The circulating currents in the brush face are set up by voltage induced in the armature coils by the alternating flux per pole. Since the circulating currents can be held to safe values by resistance leads, the exciting flux per pole at start, and for heavy currents on the 431-A motor was increased to almost twice that permissible on a motor with no resistance leads. Hence, it is not necessary to shunt the exciting field at start.

Higher Motor Voltage and Lower Current — Increasing the flux per pole increases the line voltage and lowers the line current and number of poles accordingly. Hence, the required starting tractive force of 7,000 lb. per car is obtained with only eight poles at 1,050 amp. A conventional motor without resistance leads geared for the same commutator peripheral speed would require 1,800 amp. and 12 poles for the starting tractive force.

Less Current in Cab Wiring—The lower current results in reduction in the size of the transformer low voltage terminals and the size of the car cable in the ratio of 720 to 1,120 or by 64 per cent, and in the current rating of the main circuit control apparatus.

Fewer Active Motor Parts—With a higher voltage and lower line current for eight poles, only 24 brushes are required and eight brushholders. Likewise, eight exciting field and interpole windings and only 204 commutator bars, reduces the weight, first cost and maintenance cost.

Less Armature Weight — The 204-bar commutator is only 12¼ in. in diameter and can run at 2,800 r.p.m. with 9,000 ft. per min. peripheral speed to give a car speed of 90 m.p.h. with 36-in. wheels. The lighter, high speed motor requires smaller shaft, roller bearings and pinion all of which reduces weight and cost.

One Interpole Shunt Setting — Resistance leads absorb some of the higher frequency commutating currents and sparking. The interpole excited with 25-cycle current will only compensate for 25-cycle commutation but the resistance leads will compensate at any frequency. This means less sparking at the higher speeds and currents as well as at start where resistance leads are used. As a result only one interpole shunt setting is required and control is simplified.

Low Brush Current Density — High voltage and low line current make it possible to keep brush density at lower values, 67 amp. per sq. in. at continuous rating and 98 amp. per sq. in. at starting (7,000 lb. tractive force per car).

No Breakage of Commutator Risers — Many failures have occurred in the past few years on armatures due to broken commutator risers. Armature coils are connected to the resistance leads and not to the commutator risers thus reducing the possibility of this breakage and also of burning behind necks, at the same time facilitating armature repairs if a failure should occur.

Equalization of Current to Brushholder — The introduction of resistance leads equalizes the division of load current between brushholders. On any full multiple wound armatures, there are as many parallel circuits as introduction of resistance leads equalizes the division of

(*Continued on page 73*)

Why Four-Motor Multiple-Unit Car Equipment*

New a.c. and d.c. motors and control with all, rather than half of car weight on drivers, benefit both the passenger and the railroad

By R. A. Williamson†

In 1949, steam railroad commuter traffic was crowding the 6.6 billion passenger mile record of 1926, in spite of the inroads of private automobiles. There is an increasing urge for the large city breadwinner to live farther and farther from his work, yet experience has demonstrated the utter impossibility of ever providing enough parking and highway facilities for his private automobile. Obviously then, the business of transporting him by means of large, efficient units off the public highways is bound to become more and more rather than less and less important. This type of facility is best provided by our large railroads through their suburban service in metropolitan areas. The fact that they recognize their opportunity and responsibility and intend to meet them is shown by increasing activity all along the line. The Reading, Pennsylvania and New York Central roads whose commuter territory is electrified, have recently added to, or commenced modernizing, their fleets of electric multiple-unit cars. Non-electrified roads are experimenting with light-weight, high-capacity coaches handled by diesel-electric locomotives.

Acquisition of such new equipment—which, at least in the case of the New York Central multiple-unit cars, will not even train with hundreds of older units—is one more indication of the willingness of the railroads to cut loose from the past and face the future with the recognition that 1960 times cannot be served with 1916 machinery.

Various studies (See reference 1) have shown that electric multiple-unit cars are the best means for handling suburban passengers on those roads where volume of traffic justifies electrification. They have also tended to show that, where technically possible, all-motor-car trains are preferable to motor car-trailer car combinations. Railroads currently concerned with modernizing their multiple-unit car services are apparently confirming this view by their interest in trains consisting of motor cars only. The purpose of this paper is to go further and show particularly how trains having not only all cars motored but all axles motored, readily dispose of today's problems and anticipate tomorrow's needs as well.

Nature of Requirements

Passengers want fast, comfortable, dependable low-cost service. The railroads need equipment which will fulfill the following requirements:

(a) Improve public relations through more attractive facilities and better service.

(b) Increase return on investment through greater usefulness and availability of equipment.

(c) Save money by reduced wear and tear on parts, by less need for attention, and by increased convenience of maintenance operations.

(d) Stay young and up-to-date.

Fast schedules in frequent-stop service require high accelerating and braking rates. At the same time, reasonably high top speeds are needed for express and semi-express runs, since a large suburban operation is a composite of both. Fortunately, as the commuting radius expands, it is more convenient to supply semi-express or skip-stop service. This tends to favor one design of equipment geared for all services.

The maximum practical accelerating rate for a train of two-motor cars, with 55 per cent weight on drivers, is 1.5 m.p.h. per sec. At this rate, the maximum adhesion on the driving axle which unloads because of weight transfer, reaches about 18.4 per cent. With every axle motored, 2.0 m.p.h. per sec. can be obtained with a peak adhesion of only 12.9 per cent. Even higher rates are practical; 2.5 being a modern subway standard, and 3 or 4 m.p.h. per sec. being obtained by P.C.C. cars every day on city streets, where rail conditions are by no means favorable.

High braking rates can be obtained by conventional methods without exceeding practical adhesion values, but the added wheel and shoe duty, plus the complicated mechanisms required to protect against excessive damage in case of wheel sliding become very burdensome. Trains with every axle motored are ideally suited for the use of dynamic braking, with a 2.0 m.p.h. per sec. decelerating rate, producing a peak adhesion of about 11.1 per cent and a 2.5 mile rate 14.3 per cent. Dynamic braking with only 55 per cent of the train weight on drivers (i.e., with two-motor cars) is not very attractive or practical, even the low rate of 1.5 m.p.h. per sec., producing an adhesion of nearly 16 per cent.

Adaptability of Four-Motor Equipment

Only modern equipment with every axle motored serves all the above needs best. Furthermore, better advantage can be taken of technical progress in reducing the weight of cars and equipment. Such weight reductions release motor capacity for other than purely weight hauling purposes. Trains with all axles driving can use this re-

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* Abstract of a paper presented at the Winter General Meeting of the American Institute of Electrical Engineers held in New York, January 22-26, 1951.

† Manager, Railroad Rolling Stock Division, Locomotive Car and Equipment Department, General Electric Company, Erie, Pa.

leased motor capacity to produce extra performance without exceeding workable adhesion limits. This would be impossible with two-motor equipments, whose performance is already pretty definitely limited by adhesion.

Distributing motor capacity over all axles instead of concentrating it on half the number, or less, permits using space which would otherwise be wasted to secure important high-quality design features. Truck-mounted, instead of axle-hung, motors greatly reduce unsprung axle loading. Better riding qualities and reduced wear and tear on both motor and truck parts result from the corresponding reduction in road shock. Self-contained gear units are semi-permanently axle-mounted in roller bearings. This completely eliminates friction bearings and the annoyance of gearing trouble caused by misalignment. Oil bath lubrication of gearing insures long, quiet, dependable operation. Smaller and lighter parts, and the possibility of dismounting either motor or gear unit without disturbing the other, facilitate handling and spell reduced expense. For example, the motor armature of the new four-motor a.c. equipment for the Pennsylvania weighs only 680 lb., compared to 1,880 for a comparable two-motor armature, and the motor itself weighs only 1,875 lb. instead of 5,000. Imagine what this can mean personnel- and facility-wise.

Equipment of this general type has demonstrated its ability to operate for years in difficult service with one-half to one-third the frequency of inspection required for older conventional equipment, and at two-thirds the direct inspection cost. No intermediate shopping for attention to equipment is required between overhauls, therefore, greater savings actually accrue because of fewer trips to the shop. Not only is less attention needed, but it is more conveniently given.

TABLE I—WEIGHTS OF EQUIPMENT

	New York Central 650-volt d.c. 75-ton car 1.5 m.p.h. per sec. acceleration (no dynamic brake) 70 m.p.h. maximum		Pennsylvania 11,000-volt, 25-cycle a.c. 68-ton car 1.0 m.p.h. per sec. acceleration (no dynamic brake) 85 m.p.h. maximum	
	4 Motors	2 Motors	4 Motors	2 Motors
Motor weight, lb.	10,700	10,400	11,584	12,240
Control weight, lb.	4,500	4,500	12,716	15,060
	15,200 (1)*	14,900	24,300 (2)*	27,300

*(1) Motors good for 2.0 m.p.h. per sec. dynamic braking with some reduction in car weight.
*(2) Motors good for 2.0 m.p.h. per sec. dynamic braking.

Formerly the extra weight and cost of conventional four-motor equipments as compared to two-motor equipments tipped the scales against them. Modern designs and production have now equalized and, in the a.c. case, reversed this situation. Table I shows how the weights of new four-motor equipments recently placed in service by the New York Central (100 cars) and the Pennsylvania (50 cars) compare with those of comparable two-motor equipments.

If reasonable quantities are purchased, the price of four-motor equipments is no higher than that of two-motor equipments.

Many factors, aside from the operational advantages previously described favor the use of four small motors in place of two larger ones. Some of these are:

1. Commutation constants are usually better, for both a.c. and d.c. motors.

2. Windings of both field and armature are simple and the coils are short, minimizing the effects of contraction and expansion so that they stay in good condition longer.

3. Bearings and other parts for the smaller motor cost only about one-fourth to one-half as much as those for the larger one.

The six-pole a.c. design becomes sturdy and simple enough to encourage self-ventilation. With the gear ratio available this is quite practical. It has the advantage of eliminating costly air ducts, flexible connections, external blowers, and the expense of maintaining them.

5. In neither a.c. nor d.c. designs can the motors exceed maximum safe speeds, therefore, no overspeed or slip protection is necessary. This is a new self-protecting feature in a.c. motors. Many of the conventional motors now in use will run faster on the road than the maximum safe motor speed. This protective feature, brought about partly by the new fan load, considerably simplifies control problems.

TABLE II—EFFECT OF DYNAMIC BRAKING ON BRAKE-SHOE LIFE

	Without per cent	With per cent
Trolley coach	100	300
Rapid transit train	100	500–1,300 (a)*
Diesel-electric freight locomotives and train (1)†	100	170–310 (b)*
Diesel-electric passenger locomotives and train (2)†	100	300–340 (b)*

*(a) Data obtained from rapid transit industry.
*(b) See reference (2).
†(1) Three 1,350-hp. units hauling 80 car trains.
†(2) Three 2,000-hp. units hauling 13 car trains.

6. Existing two-motor a.c. equipments have been judged too slippery to operate except with motors permanently in parallel. This requires the main motor circuits to handle very heavy currents. With accelerating adhesion reduced to one-half and the self-protecting features described, four motors can be run two in series, two groups in parallel, doubling the transformer secondary voltage and halving the current. Thus, the low-voltage low-flux, series motor design can be retained and the reasonable power circuit currents secured at the same time. This motor grouping has made possible a motor-driven, cam-operated main controller—something new to the a.c. car field and an improvement which has been sought for many years.

Dynamic Braking

Dynamic braking seems so inevitably a part of the future development of the suburban multiple-unit car that more should be said about it here. The problem of moving trains is simply a matter of pouring energy in and draining it out. Elaborate, expensive and sturdy machinery has been developed for the "in" process—yet it often is idle 25 per cent of the time the train is in motion. Certainly logic dictates putting this investment to greater use by making it serve the "out" cycle as well. This is accomplished by the addition of only a fraction of the total cost of the propulsion machinery. Against this fraction can be credited direct and secondary gains from reduced maintenance on brake shoes, wheels, brake equipment, etc.

Every transit vehicle whose performance and acceptance have shown notable improvement in the past 20

years has overcome the deceleration obstacle by adapting its propulsion machinery to braking. The trolley car adopted dynamic brakes in 1930, when it shucked off a 30-year-old shell and stepped out as the P.C.C. model. The trolley coach outgrew friction brakes in the middle 1930's and the rapid transit car a little later. After a slow start, primarily as a holding brake for diesel-electric locomotives descending grades alone, the dynamic brake has earned its place on railway locomotives to the extent that at least one large western railroad has applied it to all road locomotives, both freight and passenger, and makes its use mandatory everywhere possible—in level as well as mountainous territory.

TABLE III—APPROXIMATE ENERGY CONSUMPTION OF TRANSPORTATION VEHICLES

	Input watt-hours per ton-mile	Per cent of input dissipated by brakes
Passenger trains (streamliners, average to mountainous territory)	32	15 (a)*
Freight train (average profile)	17.2	18 (a)*
Freight train (mountainous territory)	20	44 (a)*
Trolley coach (level)	237	60
Rapid transit car	82–103	67
Suburban multiple-unit car	100–158	68–72

*(a) Estimated for trains of reference (2)

One of the reasons for this state of affairs is clearly shown in Table II. Obviously such increases in life mean substantial direct dollar savings in material and labor of application, to say nothing of indirect savings due to less handling and better planning. Evidence is available from rapid transit operations showing that wheel life is increased up to 100 per cent, which further adds to direct and indirect savings. It is reasonable to expect that suburban multiple-unit cars would show results substantially in line with those for rapid transit trains.

Not so much is known about the effect of dynamic braking or increased life of wheels on locomotive-hauled trains; but, assuming that overall life and miles between turnings can be increased from 30 to 50 per cent, savings would be at least equal to those obtained from increased brake shoe life.

The need for dynamic braking is directly related to the amount of energy dissipated in the brakes. This depends upon the energy input to vehicles in various services and the per cent of this input appearing at the brakes. Both assume formidable values in high-schedule-speed and/or frequent stop service. Table III shows approximate representative values for these two factors. Technically, among all these vehicles, the suburban multiple-unit car needs dynamic braking most, yet it is the only one not using it. Time will serve only to increasingly accent this need.

Suburban trains having all axles motored and equipped with dynamic braking can furnish smooth, quiet, fast, dependable service. They appear best suited to the future requirements of a public already accustomed to floating power and rubber tires.

Equally important, they offer the railroads just as much as they do their customers:

1. Reasonable first cost.
2. Better utilization and more intensive use of rolling stock through more versatile and dependable equipment.
3. Reduced maintenance expense through higher quality design, i.e., (a) smaller, lighter, less expensive parts; (b) more convenient to handle; less attention required, and easier to give.

References:
(1)—"Handling Suburban Traffic on Steam Railroads"—H. L. Sloman, Westinghouse Electric Corporation, A.I.E.E. Transactions Vol. 67, Part II, pages 1670-74.
(2)—"Advantages of Dynamic Braking"—J. P. Morris, assistant to vice president, Atchison, Topeka & Santa Fe, *Railway Age*, Vol. 127, No. 25, December 17, 1949, page 1087.

Resistance-Load Motors For A.C. M.-U. Cars

(*Continued from page 70*)

load currnet between brushholders. On any full multiple wound armatures, there are as many parallel circuits as there are poles or brushholders. With armature cross connections, the impedance between brushholders is low, especially for current surges and transients. The increase in resistance in paths due to resistance leads will tend to keep the current balanced in all the circuits and pairs of brushholders.

A view of the assembled motor from the pinion end, Fig. 1, shows the pinion, axle bearings, motor-lead cables and junction box, also the air intake just above the frame barrel. In Fig. 2 the nose support, safety nose, commutator covers, air intake at the rear and air outlet openings in the commutator end housing are seen from the commutator end view.

The commutator end housing, Fig. 3, complete with brushholders, forms an assembly which is located on neutral by means of the half-hole in the flange. This half-hole fits around a dowel pin set on neutral and welded in place on the frame flange. The roller bearing cartridge mounts in the bored seat and is held in place by bolts through holes drilled in the housing.

Wiring and connections of the exciting field coils are made at the rear- or pinion-end of the stator as in Fig. 4. Completely pre-insulated and baked, these coils are wound under the main pole tips by a new and novel method of first expanding the coils to pass over the pole tips and then stretching again to bring the coil sides in place against the main pole body. The interpoles have no tips and the sides are parallel. Hence, after the exciting field coils are in place, the interpole coils, pre-insulated and baked, are dropped down over the poles in the usual manner.

Interpole field connections and leads to brushholders are at the commutator end of the wound stator, Fig. 5. The air-baffle ring, also at this end, directs the air from back of the punchings down over the stator coil ends to the commutator surface. Above the frame, at the terminal board, the flexible straps from the stator wiring are shown bolted to terminal straps. These straps are mounted on insulators, two to a terminal, bolted to the frame plate. The dowel for locating neutral is not in this picture. The bolt hole, by which the dowel is held in place before welding, is between two of the housing bolt holes.

Armature coil ends are connected to resistance leads at the rear end of the armature as in Fig. 6. The ventilating air, entering at the rear, blows down over these connectors and then under the coil support, into axial holes through the armature punchings, and out again at the front end between coils just ahead of the punchings. At the commutator end of the armature, Fig. 7, the resistance leads pass from the bottom of the armature slots to the

risers of the commutator bars, thus connecting the armature coil ends at the rear to the commutator bars at the front end of the armature. The outside cylindrical surface of the risers is insulated with glass and mica and serves as a supporting surface upon which the armature coil ends are banded down in place. This allows the armature coils to expand and contract independent of the commutator risers. The commutator is of the disk spring ring type, designed for high speed operation.

It is not the purpose of this paper to develop a treatise on the theory of design of motors, but rather to point out new features of the 431-A motor, and to describe some of the advantages of this particular combination of design, chosen to produce an m.u. car motor, simple and rugged in structure, in order to give reliable service. The new motor costs less ,and weighs less than previous designs and, at the same time, provides considerable margin in rating. With fewer working parts, and simpler control, greater reliability in service and lower maintenance expense should be realized.

Lighting of Low-Bay Shop Areas

"The descriptive expressions high-bay and low-bay may at times be misleading since the proportions of the room rather than its actual ceiling height usually determine which type of lighting equipment is appropriate. In most instances, "low-bay" should be considered synonymous to "wide-bay."

"From the standpoint of seeing and physical comfort, and often economy of operation as well, fluorescent lighting is certainly recommended as the best general lighting for low-bay industrial areas. The low brightness of the lamps minimizes direct and reflected glare, their extended length softens shadows, and their high efficiency and low heat radiation characteristics make them comfortable to work under.

"The best way to position the luminaries is to mount them so that they are at right angles to the direction that most of the people in the shop face. In this position, the sides of the reflectors provide some protection against direct glare from the lamps. Installations in the 50-foot-candle class are usually laid out in continuous rows.

The foregoing is an excerpt from a 72-page, illustrated publication called "The Lighting of Railroad Properties," written by H. H. Helmbright and M. A. Mortensen, and issued by the Engineering Division, Lamp Department, General Electric Company, Cleveland 12, Ohio. The publication is profusely illustrated and deals both with the fundamentals of illumination and the lighting of specific locations. It describes means of obtaining good lighting in railroad shops, yards and stations, and deals specifically with many details such as the lighting of ticket windows, luminous signs, stairways, drafting rooms, platforms, etc.

CONSULTING DEPARTMENT

Surge Testing of Traction Motor Armatures

Can you tell me how the Westinghouse Electric surge tester for traction motor armatures works, showing a diagram of the circuits involved, and also tell me just what information it gives to the man making the test?

Surge comparison testing of insulation of d.c. traction motors, armatures, field coils, a.c. stators, transformers, and the like, combines all the advantages of previous methods and makes easier interpretation of results. As in other methods, high-frequency voltage is used to keep current through the windings to reasonable amounts while still stressing the insulation to the overvoltages likely to be encountered, from switching surges and lightning.

The main advantage of the new method lies in the way readings are indicated. Wave shapes and amplitudes of the high-frequency voltage impressed on both the winding being tested and that of an adjacent winding are

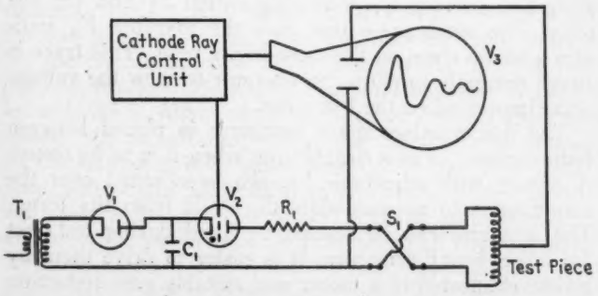


Fig. 1—Basic components of surge comparison tester

Can you answer the following question? Answers should be addressed: Electrical Editor, Railway Mechanical and Electrical Engineer, 30 Church Street, New York 7.

What is the best method to use for cleaning up slots in armature iron prior to winding or rewinding? Have you any evidence or information to indicate that improper cleaning may cause excessive core loss or hot spots?

Fig. 2—Lead arrangement and adjustment brush rigging over commutator

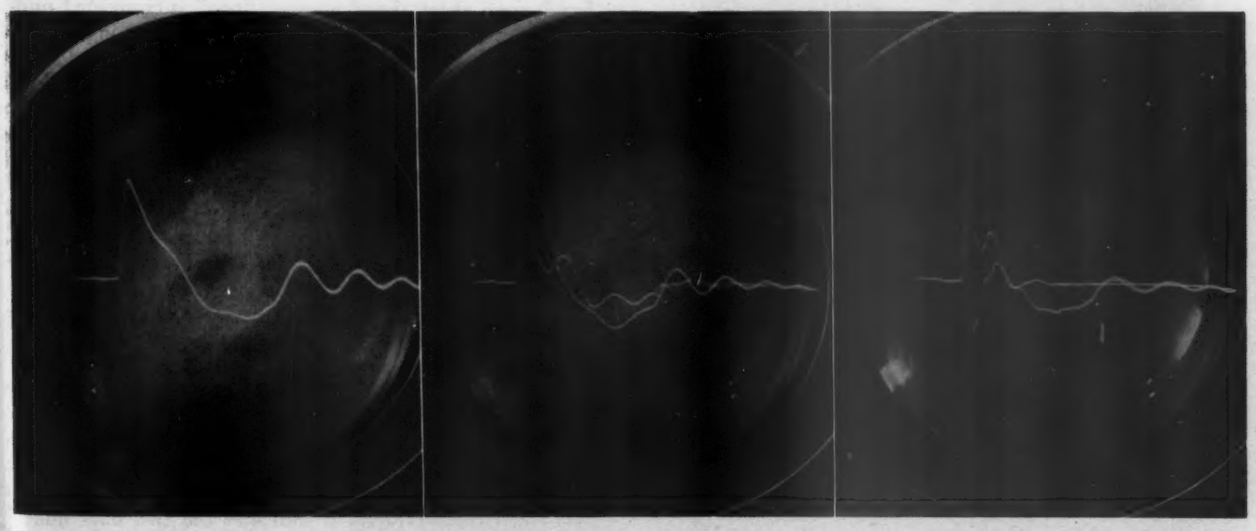


Fig. 3 (left)—Trace with good armature on test. Fig. 4 (center)—Trace showing double line encountered with shorted coil in an armature. Fig. 5 (right)—Trace showing double line encountered with a grounded coil in an armature

Fig. 6—A sample test arrangement showing brush rigging and belt for rotating armature

shown simultaneously on an oscilloscope. As different windings are checked, any faulted winding shows a markedly different wave shape and amplitude from the second trace on the screen, locating the trouble.

In the Westinghouse surge comparison tester, voltage is obtained by discharging a capacitor through the test winding. This produces a damped voltage surge with a steep front quite similar in shape to a lightning wave. As shown in Fig. 1, transformer T_1 charges capacitor C_1 through rectifier tube V_1 to some predetermined voltage. The cathode-ray control unit then pulses the grid of the thyraton tube V_2, allowing current to pass through protective resistor R_1, reversing switch S_1 and the test piece. The same pulse that fires the thyraton V_2 initiates a sweep trace on the cathode-ray tube. This trace is timed correctly to allow the operator to view the voltage wave impressed on the test piece.

Fig. 7—Portable surge comparison tester

The d.c. traction motor armature is placed between lathe centers, or in a suitable jig, when it is to be tested. A fixture with adjustable brushes is mounted over the commutator to accommodate the leads from the tester. The armature can be rotated by hand during test, but for large, heavy armatures it is easier to drive them by a belt, connected to a motor and suitable gear reduction box.

After the armature is in the fixture, leads "one" and "three" are connected to the commutator, one normal brush span apart. Lead number "two" is connected midway between "one" and "three." The winding switch should be set on "3-1." The lead marked "*G*" should make a good connection to the shaft and core. Brush and lead arrangement are shown in Fig 2. When all necessary arrangements have been made and voltage is applied to a good armature, a trace will appear on the screen similar to that shown in Fig. 3.

If there is a bar-to-bar short at any point in the armature, a trace similar to Fig. 4 will appear on the screen. The double trace will merge at different points as the armature is rotated. This will depend on the number of circuits in the armature. For a two-circuit armature, the traces will merge eight times as the armature is rotated once. A bar-to-bar short can be located by using an insulated test prod and successively shorting adjacent bars around the armature and observing the traces on the screen. If two adjacent bars are shorted and the traces move to new positions; this indicates that these two bars are not shorted within the armature. When there is no movement of the traces, it indicates the two bars under the probe are in the circuit containing the short. By observing the different points around the armature that are

in the shorted circuit, it is usually possible to pick out the one point closest to the fault.

When an armature under test contains a coil that is grounded to the core, a trace will appear on the screen similar to Fig. 5. In locating the grounded coil, it is necessary to rotate the armature and observe the traces on the oscilloscope screen. When a bar in the grounded circuit comes under the brush connected to lead "two," the traces will fall to zero and become a straight line. To locate the bar closest to the fault, it is necessary to determine which location gives the smallest voltage indication on the screen. On a two-circuit armature, there are only two bars which give nearly zero indication and usually one is less than the other.

When an armature contains two or more faults or a combination of grounds and shorts, detection of these faults is easy, but location of the faulty point becomes more difficult. The ability to locate a fault quickly depends upon the operator's experience with the tester. As the number of parallel paths in any armature increase, the difficulty of locating a fault in that armature also increases. The use of auxiliary equipment such as pick-up coils, isolation transformers, and special test circuits aid the operator in locating faults in multi-circuit armatures.

An overall test set up with a typical railway armature under test is shown in Fig. 6. One point to keep in mind while using the tester is that it should be grounded at all times and the core of the armature should be connected to the terminal marked "G" at the plug containing the test leads.

A portable model of the surge comparison tester is shown in Fig. 7. This tester is the same electrically as the one pictured in Fig. 6, except that the input power for the mobile tester is 1,840 watts, while that for the portable tester is 800 watts. The portable tester is 16½ in. wide, 26 in. high and 27 in. deep, and weighs approximately 180 lb. without cables, and 200 lb. with cables. The mobile tester is 29½ in. wide, 62 in. high, and 41 in. deep, and weighs 1,200 lb. approximately. Either model will perform the same test equally well, the only difference will be in the power input requirement and physical size.

D. W. COLLINS

Westinghouse Electric Corporation

Car Electrical Equipment

Questions and Answers

Q.—In a motor alternator, the a.c. terminals of a rectifier are connected across the secondary of a current transformer. What effect does disconnecting the d.c. terminal from the load have on the transformer and rectifier?

A.—The load should never be disconnected from the rectifier d.c. terminals unless these are short-circuited because the no load open circuit voltage across the secondary of the transformer is usually much higher than the normal voltage at rated load. The rectifier is subjected to this voltage, which, in some instances, may be more than double its allowable maximum voltage, causing it to break down electrically.

On the other hand, short circuiting the d.c. terminals cannot damage either the rectifier or the transformer because the transformer secondary current depends upon the ratio of secondary to primary turns and is, for all practical purposes, in inverse proportion to this ratio. If, for example, the primary has 10 turns and carries 10 amp., and the secondary has 100 turns, then it will carry 1 amp. When tht rectifier terminals are short circuited, this current is shunted away from the load but will remain 1 amp. and the d.c. voltage across the rectifier, which is equal to the resistance of the load, multiplied by the current, is reduced to zero.

L. B. HADDAD

Diesel-Electric Locomotive Batteries

Questions and Answers

Q.—What are the duties and functions of a diesel battery?

A.—Starting, lighting and control circuits.

Q.—What care should be exercised when working on a battery?

Using a voltmeter to locate a bad cell on a Diesel-electric locomotive battery

A.—(a) First open main battery switch; (b) Keep all flames away from battery; (c) Do not lay any tools on top of battery; (d) Provide full ventilation of battery compartment; and (e) Do not allow oil to drip or accumulate on top of the battery.

Q.—Why is it important to give attention to batteries and maintain them properly?

A.—The battery is the center of the entire electrical system of a diesel locomotive. Without the battery it is impossible to start a diesel unless an outside source of current is available. Battery maintenance is simple, but obviously, of crucial importance. Also, service life is increased.

Q.—What can you tell from open circuit readings?

A.—Open circuit voltage readings are of very little or no use in determining the true condition of a storage battery. A conventional volt meter, as used for reading diesel batteries, does not have a large enough scale to indicate the condition of a battery. Open circuit voltage readings can be used in laboratory analysis of storage batteries, but they have little or no use to the average battery maintenance man. Temperature, age and the state of charge of a battery, at the time voltage readings are taken, have a definite bearing on the readings.

Q.—Why are voltage readings higher when the temperature is low?

A.—Because of a change in the internal resistance of the cell.

Q.—What relation does temperature have on gravity readings?

A.—Correction of temperature must be made on the basis of plus or minus three points of gravity for each 10 deg. F. (acid temperature). Using 77 deg. F. as a base, add three points of gravity for each 10 deg. F. above base, and subtract three points for each 10 deg. F. below.

This correction must be considered a part of normal specific gravity readings because as the temperature of the acid rises, the acid expands and is, therefore, not as dense. The float then rides low, giving readings lower than normal. Conversely, when the acid is cold, the float rides high and the reading is higher than normal. Examples are shown in the following table:

Hydrometer Reading	Thermometer Reading	Correction	True Specific Gravity
1.250	87 deg. F.	plus 3	1.253
1.210	80 deg. F.	plus 1	1.211
1.180	64 deg. F.	minus 4	1.176

K. A. VAUGHAN
Gould Storage Battery Corporation

A.C. Air Conditioning For Railroad Cars

An experimental alternating-current drive for railroad car air conditioning, built by the Westinghouse Electric Corporation, has been undergoing trials in regular car service on the Chicago, Rock Island & Pacific. It consists of four units:

(a) The power plant is a Hercules engine, direct coupled to a 30-kva. alternator mounted as a package under the car. It can be withdrawn on rails as shown for servicing or replacement. A complete power-plant change can be made in a few minutes.

(b) The compressor unit is made up of two standard 5-hp. hermetically-sealed, motor-driven compressors, operating in separate refrigerant circuits, also built as a single, under-car package.

(c) A condenser, to remove the heat of compression combined with the engine radiator is mounted under the car as a package.

(d) Evaporators and heating coil of essentially standard design, but specially shaped, are mounted within the coach.

In cold weather the output of the a.c. generator is used to warm the car. Arrangements could be made to utilize the exhaust heat of the engine requiring no train line steam heat except for extremely low outside temperatures. The a.c. generator supplies power for all lighting, water cooler, and other electric devices.

The power plant rolled out for servicing

QUESTIONS AND ANSWERS

Diesel-Electric Locomotives

Air Brake Equipment (*continued*)

114-Q.—What is the purpose of the dynamic brake interlock? A.—The dynamic brake interlock is furnished with dynamic brake equipment and is used to release or prevent an automatic brake application on the locomotive if the dynamic brake is on.

115-Q.—How is the independent application and release effected? A.—Independent application and release of the locomotive brake is available at all times irrespective of dynamic brake operation.

116-Q.—When is the dynamic brake nullified? A.—The dynamic brake is nullified in emergency or any penalty application, allowing the automatic brake to operate.

117-Q.—What air brake equipment is used on road switchers? A.—The 6-SL equipment. Older models had the 6-DS equipment.

118-Q.—Primarily, what does this equipment consist of? A.—The automatic brake valve, independent brake valve, bell ringer valve, brake-pipe cut-out cock, feed valve and distributing valve.

Miscellaneous Equipment

119-Q.—Describe the location and operation of the locomotive bell valve. A.—The locomotive signal bell is located under the chassis behind the pilot on road locomotives and behind the right front corner steps on road switchers. It is operated from main reservoir air through the lower control valve on the right side of the brake valve pedestal.

120-Q.—Where is the shut-off valve? A.—It is built in the needle valve adjustment at the bell.

121-Q.—How is the locomotive horn operated? A.—From main reservoir air through the control valve located at the engineer's position.

122-Q.—Where is the horn shut-off valve located? A.—On road locomotives, it is located in the nose to the rihgt of the door, while on road switchers the cut-out cock is located under the cab at the front right side and is reached by opening the side door.

123-Q.—Where is the sander valve located on the road switchers and how many positions does it have? A.—It is the upper control valve on the right side of the brake valve pedestal and has three positions, reverse, neutral and forward.

124-Q.—Explain these positions. A.—The extreme left position gives reverse sanding. The extreme right position admits main reservoir air to the sander automatic valve giving forward sanding. In neutral position the exhaust warning port is closed and no sand flows.

125-Q.—Are shut-off cocks provided? A.—Yes. One for each truck, located on the right side under the chassis near the sander automatic valve.

126-Q.—Describe the sanding valve on road locomotives. A.—A single acting independent sanding valve is employed, which is operated by pulling the lever all the way back, admitting main reservoir air to the sander automatic valves.

127-Q.—Are shut-off cocks provided for road locomotives? A.—Yes, one for each truck, located under the chassis on the right side near the sander automatic valve.

128-Q.—Describe the windshield wipers on road locomotives. A.—Two wipers, operated from main reservoir, are provided, the speed of each being controlled independently by regulating valve which also turns the wiper on or off.

129-Q.—Where are they located and where is the shut-off cock? A.—One is located on the engineer's control stand, and one is on the panel at the fireman's position. The shut-off cock is located in the nose to the right of and near the door.

130-Q.—How about the windshield wipers on the road switchers? A.—Four are provided on road switchers. They are operated from main reservoir pressure, the speed of each being controlled independently by a needle valve which also turns the wiper on or off.

131-Q.—Where are the operating and shut-off valves located? A.—The operating valves are located at each wiper at front and back windows on the right and left sides of the cab. The shut-off valve is located in the bottom of the control stand and reached by removing the lower cover plate under the brake valve.

132-Q.—Where are the cab heaters located? A.—On road locomotives a heater is located on each side of the cab in front of the seats while on road switchers one is provided and it is located on the right side in front of the operator's position.

133-Q.—How do the cab heaters function and how is their output controlled? A.—Hot water from the engine cooling system passes through the heaters, and motor driven fans provide air circulation. Rheostat switch in easy reach of the operator are used to vary the output. Water inlet and outlet valves are provided for each heater.

134-Q.—Where are the inlet and outlet valves located? A.—On road locomotives they are located near the heater in the nose adjacent to the contactor compartment. On road switchers they are on the right and left sides, respectively.

135-Q.—How are air pockets eliminated? A.—A manual vent valve located on the top of each heater, is provided for this purpose. This valve should always be opened when draining water from the engine.

136-Q.—Are these locomotives equipped with defrosters? A.—Road locomotives only are equipped with two motor driven defroster fans, which blow cab heater air on the insides of both windshields. Each motor is operated individually by a rheostat switch which will vary the output of the defroster as well as turn it on or off.

137-Q.—Where are the switches located? A.—One on the operator's control stand and one on the fireman's panel.

138-Q.—Are classification lights provided? A.—Yes. On original model road locomotives on each side of the nose having bulls-eye lenses, one facing forward and one to each side. On new design locomotives one lens is provided on each side which reflects light forward and to the side.

139-Q.—Describe the lights further. A.—Accessible from the nose is a classification light lamp on original model locomotives cage containing three colored lenses; red, green and yellow. On new locomotives colored lenses are mounted in a pivot-type frame and dropped into position.

140-Q.—How is the desired color obtained? A.—The cage is equipped with a locking pin which when pulled out disengages the locking device so that the cage or pivoted lens may be positioned to obtain the desired colors. When the colored lenses are out of position, the white light will show, thus making several combinations available.

Schedule 24-RL Air Brakes

Safety Control Feature (*continued*)

1031-Q.—What must be done to move piston 161 to release position? A.—Pressure must be equalized on both sides of the piston.

1032-Q.—How is this accomplished? A.—It is necessary to move the brake valve handle to lap position, cut off supply to brake pipe port *2b* and depress either the brake valve handle or the foot valve, or make an independent application with about 30 lb. in control pipe *16*.

Over Speed Protection Feature—H-24-D-Relayair Unit

1033-Q.—When does the Overspeed Protection Feature function? A.—When the engineman fails to keep the train below a predetermined speed.

1034-Q.—What happens if the speed is not thus held reduced? A.—An application of the brakes will occur.

1035-Q.—What does the overspeed feature as installed with this brake equipment consist of? A.—(1) FA-4 magnet valve. (2) Overspeed whistle. (3) Volume reservoir and check valve with choke. (4) Service application brake valve overspeed control details, or Emergency application valve overspeed control details.

1036-Q.—How does the FA-4 Magnet Valve function? A.—Operates the service or emergency application piston of the brake valve to cause a brake application when overspeed prevails.

1037-Q.—What is the purpose of the overspeed whistle? A.—The overspeed whistle blows to indicate that an overspeed brake application is initiated.

1038-Q.—What is the purpose of the volume reservoir and check valve with choke? A.—To stabilize the operation of the brake service application piston *112*.

1039-Q.—What does the service application brake valve overspeed control details consist of? A.—Cut-out cock *134*, service application piston *112*, and slide valve *114*.

1040-Q.—What does the emergency brake application valve overspeed control details consist of? A.—A cut-out cock in pipe *10* and an emergency application piston *161*.

1041-Q.—When equipped with the service application portion and with the train operating at normal speed, how is the overspeed control system charged? A.—By main reservoir air from chamber *A* located below service application piston *112*, of the brake valve.

1042-Q.—How does the air flow through the brake valve? A.—Through choke *K* in piston *112* to chamber *B* and passage *10* to pipe *10*.

1043-Q.—From pipe 10 where does the air flow when charging? A.—To the volume reservoir with check valve and choke, the H-24-D Relayair valve unit and the FA-4 magnet valve.

1044-Q.—How are the volume reservoir and H-24-D Relayair valve unit charged? A.—The volume reservoir is charged through the check valve and choke and the relayair valve unit is charged as previously described under safety control.

1045-Q.—What is the first movement as overspeed occurs? A.—The *FA-4* magnet valve is de-energized.

1046-Q.—With the magnet valve de-energized, what then is the result? A.—Spring *4* moves lower valve *3* off its seat and seats upper exhaust valve *3a*.

1047-Q.—What flow of air is the result of this movement? A.—Air from chamber *A* flows to chamber *B* and the overspeed whistle, which blows, indicating that an overspeed application is initiated.

1048-Q.—How then, is an application of the brakes brought about? A.—Air from the volume reservoir and from chamber *B* on top of the brake valve application piston *112* is quickly vented through the FA-4 magnet valve, overspeed whistle pipe and the overspeed whistle. Thus piston *112* is moved up to "Application Position."

1049-Q.—How does the Emergency Application Portion function? A.—As explained under Safety Control when the No. *10* pipe is vented through the FA-4 magnet valve.

1050-Q.—How many relayair valve units are used with the H-24-D unit? A.—One. The Cut-off relayair valve unit.

1051-Q.—How does the Cut-off relayair valve function? A.—To suppress a safety control application when the brake is applied with about 30 pounds pressure in the relay valve control pipe *16*.

1052-Q.—What also does this valve provide? A.—Permanent suppression when used with the overspeed suppression relayair valve.

Overspeed Protection Feature with H-24-E Relayair Valve Unit

1053-Q.—How does the overspeed protection feature as incorporated with this equipment, function? A.—When the engineman fails to keep the train below a predetermined speed.

1054-Q.—Do the brakes apply immediately? A.—No. However, if the speed is not reduced manually or the brake is applied which will bring the train speed below the overspeed setting within 6 seconds after the overspeed whistle sounds, a brake application will occur.

1055-Q.—What does the overspeed protection feature with this equipment consist of? A.—Similar to that of the H-24-D-Relayair Valve Unit with the addition of an overspeed application valve.

1056-Q.—How does the overspeed application valve function? A.—To initiate a brake application when overspeed occurs, as controlled by the FA-4 magnet valve.

1057-Q.—How is the overspeed control system charged? A.—By main reservoir air from chamber *A* below service application piston *112* to chamber *B*, passage *10* to pipe *10*.

1058-Q.—Describe the flow from pipe 10? A.—From pipe *10* to cononnection *17* of the *H-24-E*-Relayair Valve where it connects with passage *7* and flows to the overspeed application valve.

1059-Q.—What is the position of the overspeed application valve with train operating at normal speed? A.—With train operating at normal speed and no air pressure in chamber *E*, diaphragm *10* is held in its upward position by spring *6*. This unseats upper valve *17* and permits spring *19* to move lower valve *15* to its upper seated position.

1060-Q.—How does this set up affect the overspeed control system? A.—Main reservoir air from passage *7* and pipes *17* and *10* and the brake valve service application piston chamber *B* is cut off from the atmosphere.

1061-Q.—What takes place when overspeed occurs? A.—The FA-4 magnet valve is de-energized.

1062-Q.—What results from de-energization of the magnet valve? A.—Spring *4* moves supply valve *3* off its seat and seats exhaust valve *3a*.

1063-Q.—What flow of air is then permitted? A.—Main reservoir air from pipe *2* and chamber *A* then flows past unseated valve *3* to chamber *B* and into the overspeed actuating pipe *1*.

Steam Locomotive Boilers

Oil Versus Coal

Q.—Some consideration has been recently given on our road to converting several of our steam locomotives from coal to oil burning. Is there any available data on the consumption of oil versus coal for a steam locomotive?—S. T.

A.—The Bureau of Railway Economics published, in 1942, a statement showing the unit performance with each of the several kinds of fuel used in road freight service, road passenger service and yard switching service for individual Class 1 railroads of the United States. The comparison of oil and coal consumption given is summarized as follows—

Switching Service—per Locomotive Hour
Pounds of coal—steam locomotives 766
Gallons of fuel oil—steam locomotives 58.28
Freight Service—per 1000 gross ton-miles (including locomotive and tender)
Pounds of coal—steam locomotives 113
Gallons of fuel oil—steam locomotives 8.10
Passenger Service—Per car-mile
Pounds of coal—steam locomotive 16.8
Gallons of fuel oil—steam locomotives 1.06

Factor of Safety

Q.—How is the factor of safety arrived at? For locomotive boilers it is 4. What I want to know is how to arrive at that 4.—E.F.K.

A.—The term "factor of safety" is defined as the ratio of the ultimate strength of material or structure to the allowable stress.

In boiler work the term factor of safety can be taken as the ratio of the bursting pressure to the working pressure, thus:

$$\text{Factor of safety} = \frac{\text{Bursting pressure}}{\text{Working pressure}}$$

All locomotive boilers operating in the United States

By George M. Davies

must have a factor of safety of 4 to comply with the locomotive inspection law.

This law requires:

Rule 2—The lowest factor of safety for locomotive boilers, which were in service or under construction prior to January 1, 1912, shall be 3.25.

Effective October 1, 1919, the lowest factor shall be 3.5.

Effective January 1, 1921, the lowest factor shall be 3.75.

Effective January 1, 1923, the lowest factor shall be 4.

The factor of safety of 4 is an arbitrary margin of safety set by law to protect against:

1. Deterioration due to corrosion.
2. Errors in workmanship.
3. The interdependence of parts.
4. The probability of overload.
5. Stresses due to method of suspension.
6. Lack of homogeneity in the material.

The factor of safety computed by the following formula must not be less than 4 in order to comply with the locomotive inspection law:

$$FS = \frac{TS \times t \times E}{R \times W \times P}$$

where

T=ultimate tensile strength stamp on shell plates, lb. per sq. in.
t=minimum thickness of shell plates in weakest course, in.
E=efficiency of longitudinal joint or ligaments between tube holes (whichever is the least).
R=inside radus of the weakest course of the shell, in.
WP=allowable working pressure, lb. per sq. in.
FS=factor of safety.

EDITORIALS

Air-Conditioning Still Presents Problems

In a discussion of air-conditioning equipment design and maintenance at a recent meeting of the Car Foremen's Association of Chicago, numerous problems or difficulties in operation were cited and suggestions advanced for effecting improvement.

For example, it was explained that water-cooled condensers in early designs tended to collect road dust and cinders, particularly in the West, to such an extent that condenser sumps had to be cleaned after each trip. Clogged sprays, burned-out pump motors and defective controls soon proved the impracticability of this type of condenser. With the introduction of Freon, air-cooled condensers became feasible and the first of these were well built, electrically driven and generally separated from the compressor location to minimize vibration. Low maintenance and practically leak-proof trouble-free operation were additional advantages.

When high-production methods and possibly other reasons led to combining the compressor box, condensers and condenser fans in a single unit, however, practical car men found that not only was the compressor unit difficult to service but it proved a continual source of Freon leaks, broken piping and inefficient air supply to the condensers. Many postwar installations have accordingly returned to the use of water-cooled condenser units which completes the cycle and almost seems like looking for trouble. In defense of the water-cooled condenser, it may be said that post-war types have been greatly improved and designed to overcome most of the difficulties experienced with earlier designs.

Similarly, air distribution, particularly in sleeping cars, confronts designers with problems not yet entirely solved. In first attempts to air condition these cars, cooling coils were located in individual rooms or compartments, each with its own air filter and fan and designed to circulate air in a limited area quietly, quickly and evenly with individual control. To reduce costs, all of this equipment was eventually consolidated in a single over-head air-cooling unit which must force air from one end of the car to the other through limited duct areas with proportionately high pressures and velocities, drafts and wind noises.

It was pointed out at the meeting referred to that the human element enters at this point and often results in one passenger after another shutting off his individual air damper, thus causing a progressive increase of air delivery to remaining accommodations. By that time the noise from air outlets may become highly objectionable and possibly cause all of them to be closed with attendant serviceing of the cooling evaporator. Both railway engineers and manufacturers' experts are concentrating on this one.

Core Loss and Hot Spots

Reduction of traction-motor capacity, due to increased core loss, has been discussed previously in these columns, but up to the present time there appears to be little information available on the subject. It has been suggested that some of the methods used to clean armature cores for rewinding may burr over the edges and thereby short-circuit the laminations sufficiently to cause an objectionable increase of core loss. This, in turn, might cause sufficient heating to reduce appreciably the motor's thermal capacity.

In discussing the question, one of our British contemporaries, W. S. Graff-Baker, chief mechanical engineer, London Transport Executive, Acton Works, London, tells of an early experience. He relates that when he came out of college, he was somewhat shocked to find cores being filed. To evaluate the question, he had four blocks made of armature stampings of similar size and shape. One block was left untouched, one was filed, one drifted and one milled, respectively. The four blocks were provided with like coils on a like number of teeth. For purpose of test, the coils were connected in series and an alternating current passed through the coils. It was found that the temperatures of the blocks were not affected by the method of dealing with the slots; all blocks came up to the same temperature. In looking back on this experiment, Mr. Graff-Baker thinks he may have overlooked the fact that the frequency of the alternating current flux in the teeth of an armature in regular service is considerably higher than the frequency of the current used in the test.

In other words, the result of such tests leaves the question of traction motors still in doubt, and in an attempt to shed light on the subject, a question is published in the Consulting Department of this issue which reads as follows: "What is the best method to use for cleaning up slots in armature iron prior to winding or rewinding? Have you any evidence or information to indicate that improper cleaning may cause excessive core loss or hot spots?"

Tests have been made on the stators, (armatures) of a.c. machines, in which test windings were applied and the cores painted with paraffin. Current values were increased until the paraffin was melted. In some cases, the paraffin melted first in small localized areas or hot spots.

It seems quite possible that in the case of traction motors, the faults might be confined to spots, a circumstance which could be more harmful than a slight increase in temperature over the entire armature.

At least, the question still remains. Perhaps someone has made tests which show conclusive answers. If not, descriptions of the practices used in manufacturers' or railroads' shops may shed light on the subject, since they are based on experience. Readers are invited to discuss the subject.

Logical Extension Of the Assembly Line

One of the important factors in the ascendency of the diesel locomotive over the steam has been the continuing reduction in the price differential between the two forms of motive power. The principal reason that the diesel manufacturers have succeeded in narrowing the gap has been that their product has been standardized to a vastly greater extent than steam locomotives, and the standardization has permitted the economic adoption of the assembly-line or production-line technique.

The same technique can be and has been applied to maintenance work, although to a lesser extent for the simple reason that repair work in general does not by its nature lend itself to production methods as well as manufacturing. There are, nonetheless, numerous operations to which the production line theory has been applied successfully. Assembly lines have been set up on different roads for such things as overhauling complete diesel engines at eight or ten stations to comparatively small items such as cylinder heads and injectors at about half that many stations.

Few if any people doubt the advisability of setting up production lines where the volume of work is sufficient to justify the cost of the setup. The big division of opinion arises over the number of any given part that must be repaired during a period of time to make the cost of the added facilities worth while. One thing that can cause this number to vary between different shops is the facilities currently employed in the present repair setup. One shop may have facilities that can be converted to a production setup at far less cost than another shop, and this of course would justify the production or assembly-line arrangement for a smaller volume of work.

In general, however, the majority of shops should not find too much variation in the cost of putting repairs to any certain part on a production-line basis. There is probably cause to investigate when any but minor discrepancies exist between the volume that one shop considers sufficient to justify an assembly-line repair and the volume that a second shop feels is needed. The potential savings from selective assembly-line repairs are too great to risk their being overlooked, not only from the saving in cost of the particular repair, but as well from the increased quality that frequently results from having the same man perform the same operation every day.

NEW BOOKS

STRENGTH OF STAINLESS-STEEL STRUCTURAL MEMBERS AS FUNCTION OF DESIGN. *By Michael Watter, D.Eng., director of research, Budd Company, and Rush A. Lincoln, D.Sc., Allegheny Ludlum Steel Corporation. First edition. Published by the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. 154 pages, 8 in. by 10½ in.; cloth bound. Price, $5.*

This book discusses the basic properties of light-gauge stainless-steel strip of various tempers at room temperatures, and methods for calculating the allowable loads for structures made from it. Its contents are for the most part taken directly from unpublished reports D-1 and 110 by Dr. Michael and members of the research and development department of the Budd Company. These data were organized and supplemented by Dr. Lincoln. The first 84 pages, with the accompanying first 61 figures, represent a detailed description of the basic properties of stainless steel. On the next five pages these data are applied to the behavior of columns. A simplified procedure for calculating column failures that occur through buckling in compression without twisting is then described, followed by an explantion of the origin of the data used. Behavior in bending and shear is then discussed. In the last part of the book the data are adapted to the analysis of open-section columns in compression that fail by twisting.

MECHANICAL ENGINEERING LABORATORY. *By Charles W. Messersmith, professor of experimental mechanical engineering, and Cecil F. Warner, associate professor of mechanical engineering, Purdue University. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. 160 pages, 8½ in. by 11 in.; paper covered; plastic binding. Price, $3.50.*

A set of notes prepared for students in mechanical engineering at Purdue University is the basis for this book. Chapter 1 sets forth the objectives of a laboratory course. The text material of succeeding chapters is arranged in a way to satisfy those objectives as far as possible. Material usually covered in thermodynamics and heat-power textbooks has been omitted where possible, and much has been done to reduce to a minimum the number of equations in which students can "plug in values and crank out answers." Test codes and procedures formulated by various engineering societies are frequently referred to in order to remind the student that such guides exist and should be consulted as well as various handbooks and other works of reference. Pointed out also is that one of the aims of any mechanical engineering laboratory course should be to improve the report-writing ability of the student. Pressure, temperature, power, and flow measurements are treated in separate chapters. The remaining chapters cover Heating Value of Fuels, Selected Physical Properties of Lubricants, Analysis of Flue Gas or Products of Combustion, Fluid Pumps, Stationary Steam-Generating Units; Steam-Driven Prime Movers, Heat Transfer, Internal Combustion Engines, and Vapor Compression Refrigeration Plant.

NEW DEVICES

Bicolored Fused Lenses

Illustrated here is a set of bicolored fused lenses, designed to protect the eyes of workers engaged in heat treating and furnace operations, scarfing and burning operations, open hearth and blast furnace operations, kiln processes and welding. They have been designed and are manufactured by the American Optical Company, Southbridge, Mass.

Because the lenses are fused into one piece, uniform thickness is assured, and they have no rough edges. The lenses are beveled to fit spectacle goggles or cup-type goggles and are made in regular and 6-curve, round and FV3 shapes.

In comparison with their older two-piece bicolored lenses, the new fused type can be replaced more easily and quickly in goggle frames. The fusing process at the same time, eliminates the possibility of light streaks being present.

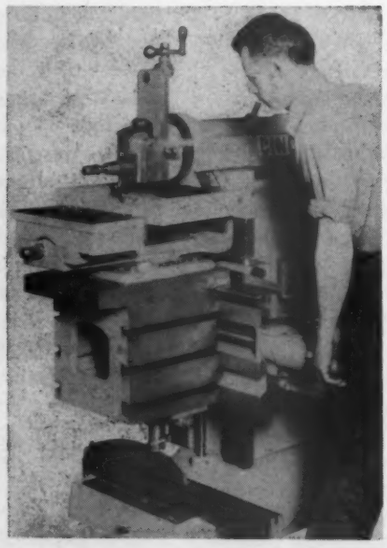
The following glass combinations are available: cobalt-clear; Noviweld-clear; calobar-clear; and Noviweld-Calobar in one-half and one-half combinations.

Nipple Chuck Threader

A nipple chuck for the threading of short nipples has been announced by the Ridge Tool Company, Elyria, Ohio. This Ridgid nipple chuck is of a design which fits any threading machine or vise without special tools, parts or adjustments, according to the manufacturer.

It requires no adjusting or changing of the stop plug which is an integral part of the device, and is said to be always automatically in position for use. Nipples to be threaded are screwed in by hand, and after threading, are released by a turn of the chuck, so they can be unscrewed by hand.

Pipe adaptors are made for ⅛, ¼, ⅜, ½, ¾, 1, 1¼ and 1½-in. pipe; the nipple chuck itself holds 2-in. pipe. A handy patented carrier is furnished with each complete set.



Follower Type Duplicating Shaper

The unit illustrated is used for automatically shaping contours on dies, clamps, cams and other parts without laying out the contour on the work and shaping to a line as is normally done when shaping parts. This device, a follower type shaper, has been brought out by The Cincinnati Shaper Company, Cincinnati, Ohio.

Follower equipment can be supplied on any stroke or size of Cincinnati Shaper. It can be used for regular shaper work as well as automatic duplicating. Changeover is simple and quick.

The rail elevating screw is disconnected and retracted when duplicating so the table and rail are free to move vertically. Rail and table are supported on the masterform by the steel support post equipped with a roller. The masterform to be duplicated is made of ½ in. steel and clamped in the holder that is secured to the pad on the base. The table progresses horizontally by automatic feed. Table, rail and work follow the vertical and horizontal movement of the roller as it travels over the masterform.

As shown, a die can be machined by feeding the tool down in consecutive cuts to rough out the die and with a final finish cut to complete the surface. The limiting angle of climb is approximately 20 deg.

Cincinnati Shapers may be equipped with other types of duplicating followers for more intricate contours or shapes.

Journal Box Plug Retainer

A journal box dust guard plug retainer that holds plugs in place in spite of vibration, car dumping, and other severe service conditions has been placed on the market by the Gustin Bacon Mfg. Company, Kansas City, Mo.

These retainers can be used with all types of wood dust guard plugs now in common usage. They can be applied without disassembly of the journal. No bending, locking or fitting is necessary—the retainer is slipped over the plug, and automatically locks as it is driven into place. It can be removed and used over and over again.

Manufactured of spring steel, it affords positive locking to both sides of the dust guard well.

Megger Ground Tester

An instrument for measuring resistance to earth of ground connections, called the CVM Megger Ground Tester, is now being marketed by the James G. Biddle Company, Philadelphia 7, Pa. It provides a dependable and easy method for ascertaining if the resistance to earth of man-made grounds is sufficiently low to insure their correct operation and to minimize dangers due to lightning.

The set has its own generator for supplying test current and is therefore always

ready for service without dependence on battery or other supply. Each instrument has two scales, permitting open well-proportioned markings. Two ranges are available, 0 to 40 and 0 to 200 ohms; 0 to 100 and 0 to 500 ohms.

Corrosion Resistant Aluminum Paint Base

A patented process is now being offered to others for the protection of aluminum. This Pylumin process, developed by the Pyrene Manufacturing Company, Newark 5, N. J., accomplishes two things. It gives an attractive coating definite corrosion-resistance value if no paint finish is applied. In addition, it protects the metal by providing an adhesive and efficient base for paint finishes.

The manufacturer claims that Pylumin is simple to operate since it is an immersion process and employs a single powder whose ingredients have been proportioned and pre-mixed. The solution is easily maintained by a simple test kit and, when necessary, by the addition of the single powder. The costs of installation and operation are also low. Ordinary heated steel tanks are all that is required. Unless there is an exceptional amount of grease and dirt on the parts to be processed, no special cleansing is required.

This process is adaptable to either large or small scale production and it can be used widely on varying products made of aluminum and aluminum alloy. There being no dimensional changes, it is not necessary to make allowances for close tolerances.

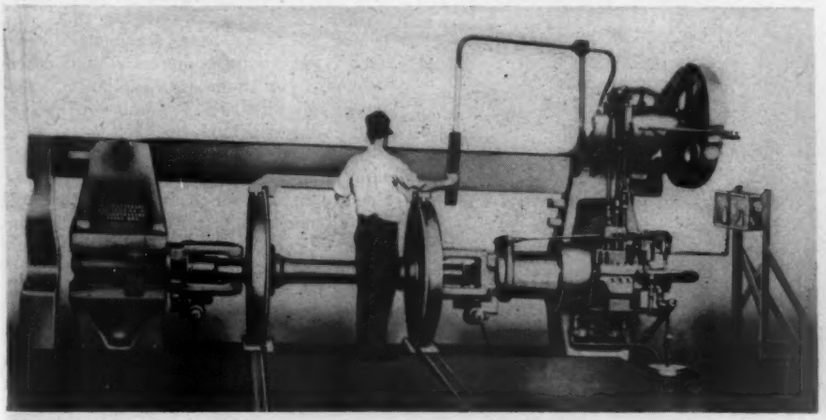
Car Wheel Mounting Press

The illustrated unit features centralized electrical push button controls, by means of which all the operations necessary to press MCB standard car wheels on their axles can be handled by a single operator. These push buttons are mounted on a pendant suspended from an adjustable swing arm, permitting wide latitude in the operator's movements.

With this press, available from the Chambersburg Engineering Company, Chambersburg, Pa., one man can mount and gauge the wheels from the same station. This effects a saving in labor over the conventional mounting press, where one man gauges while another operates the press by individual manual controls.

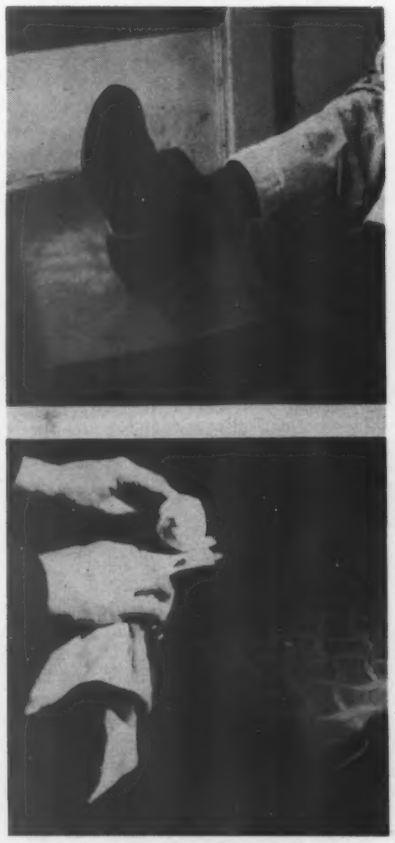
Electrical controls on the Production Mounter provide for operation of the press ram, control positioning of the stops in the yokes and operate the pneumatic "kick-out" cylinder in the resistance beam to push the completed assembly free of the yoke for rapid removal from the press.

Mounted one above the other on the pendant, the push buttons are provided to: Advance the ram quickly under air pressure; apply hydraulic pressure rapidly, moderately, or inch; hold pressure at any desired tonnage; instantaneously release all pressure; position right-hand or left-hand stop within the mounting yokes; and operate the "kick-out" plunger.



Electric Hand Tachometer

A hand tachometer, Type 25D, with speed measuring ranges of 100 to 1,000, 200 to 2,000 and 500 to 5,000 r.p.m. and 10 to 100, 20 to 200, and 50 to 500 r.p.m., has been made available by the Metron Instrument Company, Denver 9, Colo. These are new ranges, and suited for speeds encountered in motor and generator testing, process control, and maintenance work. Range extending adapters are available to measure speeds as low as 20 r.p.m. and as high as 50,000 r.p.m. for special applications. The meters have quick response and can be used for acceleration tests. They have a self-calibrating check circuit and are undamaged by overspeeding or selection of wrong range. They have low operating torque, and the maker assures sustained high accuracy with long life.



Glass Fiber Coach Seats

Carelessness of commuters has little effect on railroad coach seats covered with fabric made of woven glass fiber coated with Vinylite resins. Coated with these resins, the illustrated glass fiber upholstery and window shade fabric is manufactured by Cordo Chemical Corporation, Norwalk, Conn.

This coating provides resistance to wearing stress that enables the material to survive flexing, and such pressures as a woman's high heel on the seat, as well as abrasion of foot-resting shoes (top). Dirt and soot, oil and grease, mildew and food stains (bottom) are easily removed with soap and a damp cloth. The fabric's resistance to fading, tearing and stretching are said to combine to make it ideal for rail coach window shades.

Vinylite resins in the material protect it from the sulfuric acid fumes in soft

coal smoke. If discolored by a cigarette, the fabric can be retouched with Vinylite resin solution in a matching color.

The material is available in a variety of colors and patterns, and is priced in the range of medium grade upholstery fabrics.

Traveling Table Grinders

Three additional sizes have been added to a line of plain grinding machines and traveling table roll grinding machines. The new sizes are 16 in. heavy duty and 20 and 24 in. plain grinders; and 16, 20 and 24 in. roll grinders. They are manufactured by the Cincinnati Milling Machine Company, Cincinnati 9, Ohio.

The grinding wheel spindle bearings are the Filmatic type. This construction consists of segments which are free to rock slightly in the housing bore, thereby admitting wedge shaped oil films between them and the single journal diameter as rotation occurs.

A d.c. motor, controlled electronically from an alternating current source, drives the table through a rack and pinion. This type of drive provides dial selection of an infinite number of traverse rates from 3 to 120 in. per min. To eliminate shock, the table automatically accelerates and decelerates at table reversal. Table tarry may be adjusted independently at each end of the stroke. Coolant flow and headstock spindle rotation automatically start and stop with the table traverse, or independently, as desired. An individual circulating system supplies filtered oil to the grinding wheel spindle bearings. A second circulating system automatically lubricates the table and cross ways.

The headstock is a dead spindle, d.c. motor driven unit, having a speed range of 20 to 72 r.p.m. for the 16 in. size, and 15 to 54 r.p.m. for the 20 and 24 in. sizes. The taper hole in both headstock and footstock spindles is No. 15 Brown & Sharpe.

Plain machines are built in seven lengths at two foot intervals, from 48 to 192 in., while the roll grinder style is built in the same lengths up to 168 in. Principal power requirements are 20 hp. for wheelhead motor; 2 or 3 hp. for headstock motor; 1½ hp. for table drive motor.

Wing Type Work Glove

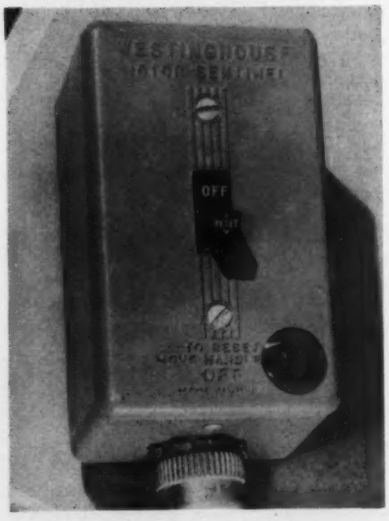
An all purpose work glove with a wing-type thumb has been announced by the Richmond Glove Corporation, Richmond, Ind. It is designed for heavy materials handling wherever protection is required.

An outstanding feature of the glove is the all-leather "Dura-Thumb". One continuous seam on the back of the glove's thumb assures long life. It eliminates seams on the front and thus insures more usability where thumb meets the palm.

Made of chrome-tanned, side split, pearl-grey cowhide with striped herringbone flannel back, the glove has a water-resistant cuff which may be dry cleaned. It has a seamless first finger and reinforced welting around the second and third fingers. A double stitch is used along the back cuff to the first finger for greater strength. A heavy elastic band is used for form fitting around the wrist.

A separate "pull" blends neatly into the matching cuff. It has a flannel lining which is provided for finger and palm comfort while leather knuckle straps and tips also offer additional hand insurance.

Gloves are available in two types, the Wing King with a 4½ in. gauntlet or the Super B with a 2½ in. safety cuff.



Manual Starter With Indicating Light

An improved manual starter, the Motor Sentinel Class 10-023, equipped with an indicating light to show when the motor is running, is available from the Westinghouse Electric Corporation, East Pittsburgh, Pa. Useful for starting and protecting small a.c. and d.c. motors used with fans, pumps, compressors and other industrial or domestic appliances, the starter is available as a double-pole switch with ratings up to 1 hp., 250 volts.

Quick-make quick-break action to insure rapid and positive operation is provided by an over-center, self-indicating toggle mechanism in this new motor starter. Positive bimetallic overload protection allows safe-capacity overloads, but automatically disconnects the motor on sustained or damaging overload. Proper selection of replaceable heater allows sufficient delay for small motor starting.

The device is housed in a N.E.M.A.

(Continued on page 90)

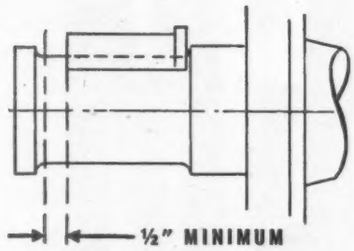
New GAEX-DF "DAMAGE-FREE" Box Cars

. . . give lading the smoothest, safest ride, on AAR Solid Journal Bearings

Here's a new type box car specially designed to give our railroads a bigger *net* return. It's "Damage Free" . . . no effort or expense spared by General American Evans to keep the lading safe . . . built to keep on the road, too, with high monthly mileage and quick, easy maintenance as essential requirements.

The journal bearings purchased for GAEX-DF cars are Magnus-made AAR solid-type bearings. That's because solid-type bearings are essentially "free-floating" on the journals — not only take but cushion shock thrust loads before they reach the car and lading. And you also get a greater potential in ton-miles per hour with minimum operating and upkeep costs.

For complete information on "D-F" cars write to the General American Evans Company, at 2842 W. Grand Blvd., Detroit 2, Michigan. And be sure to get your copy of "The FACTS About AAR Solid Journal Bearings" by writing to Magnus Metal Corporation, 111 Broadway, New York 6, N. Y.



½" MINIMUM LATERAL MOVEMENT of bearing on journal CUSHIONS SHOCK THRUST LOADS.

That's why AAR solid bearings make car bodies last longer — give minimum wear on wheel flanges — and reduce the possibility of damage to lading.

MAGNUS METAL CORPORATION
Subsidiary of
NATIONAL LEAD COMPANY
New York, Chicago

Here's why AAR Solid Bearings have no equal for railroad rolling stock

MAXIMUM DEPENDABILITY: In high speed service, a record of 42,000,000 car miles without a "heating."

LOWEST ACCELERATING AND RUNNING RESISTANCE: Glides on a single film of oil, like a skater on ice.

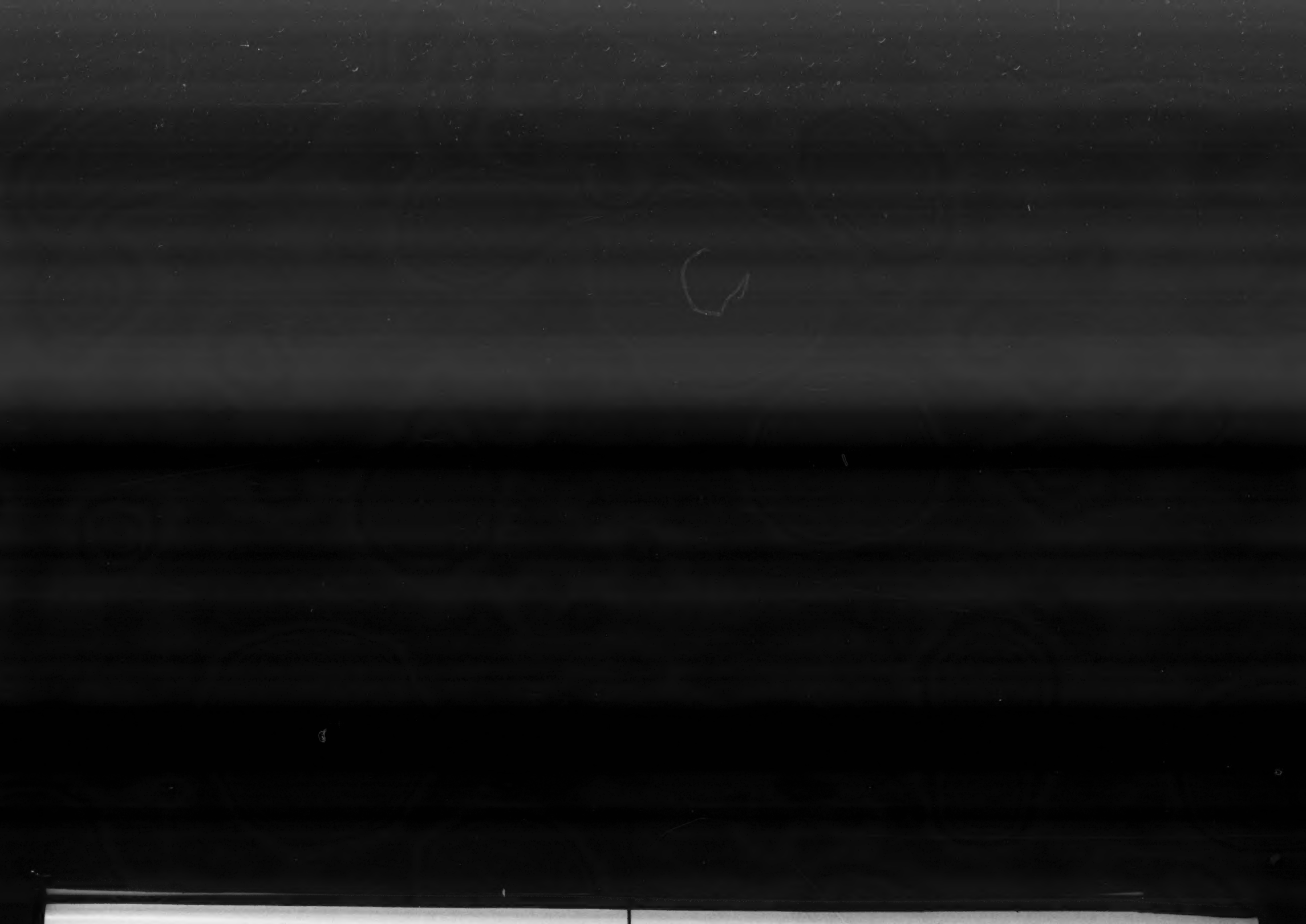
EASE OF MAINTENANCE: Can be fully inspected or replaced on the line in about 10 minutes. No shopping required.

UNIVERSAL INTERCHANGEABILITY: Simple — dependable — economical — safe.

LIGHT WEIGHT: Saves many tons of excess dead weight on every moving train.

ROCK BOTTOM COST: Saves over 25% on initial car cost — 96% on bearing replacement.

GM Diesels are the best railroad security



(*Continued from page 86*)

type I enclosure suitable for general purpose application. Straight-through wiring and accessible front terminals allow easy installation and service. Made of die cast aluminum the enclosure is Bonderized and has a lustrous gray finish.

Horizontal Duplex Air Compressor

Utilization of roller bearings instead of conventional sleeve-type bearings in the running gear on the horizontal duplex compressor is a feature of the units developed by the Chicago Pneumatic Tool Company, New York 17.

Spherical roller main bearings support the crankshaft and are also used at the crank pin end of the connecting rod; double row needle bearings are used in the crankhead end of the connecting rod.

The recent development of the oil injection system of bearing removal, when applied to compressor bearings and crank discs, makes the application of roller bearings throughout practical.

These bearings are self-adjusting, and have a life expectancy equal to that of the compressor itself.

The oil injection system of bearing and crank disc installation or removal permits use of one-piece crank discs and connecting rods.

Bearing or crank disc removal and replacement can be accomplished with ordinary hand tools and a portable, hand-operated, hydraulic pump . . . no heavy pullers or presses are needed on the job.

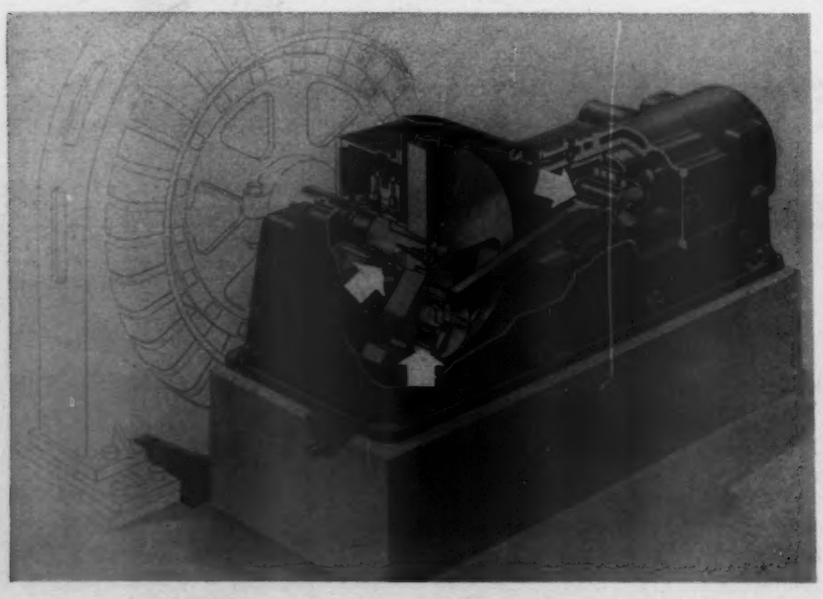
A simple hydraulic pump is used in the oil injection method to inject oil between the bearing or crank disc and tapered shaft. The oil pressure expands the part inner bore and the oil film reduces friction between the parts as the pressure separates the contacting surfaces; this friction loss and resultant axial component of force causes the crank disc or bearing to pop off.

Adjustable Beam Clamp

The Thompson Electric Company, Cleveland, Ohio, announces the development and production of a heavy-duty, adjustable beam clamp which has been designed to suspend heaters, motor platforms, lighting fixtures, fans or blowers, conveyors, exhaust ducts, loudspeakers, and other types of overhead-mounted equipment from structural members of buildings. Featuring quick, easy attachment, this cast malleable iron beam clamp will support loads up to 1,500 lb. It is heavily cadmium plated for corrosion resistance.

The clamp can be attached to standard I, inverted T, or H beams, as well as trusses and girders consisting of angles or channels back-to-back. It will fit heavy structural members ranging from 4 to 8½ in. in width. Installation adjustment is accomplished by means of two bolts and nuts. In addition, the clamp is tapped for a 1¼-in. pipe thread connection.

The clamps can be equipped with a new adjustable angle fitting, as shown in the illustration, which provides for vertical suspension from sloping or arched roof members. The adjustable fitting also permits angle mountings from wall posts or columns.

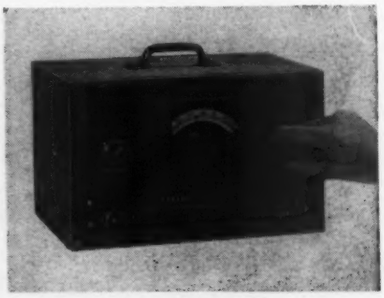


Hard Surface Plastic Covering

A vinyl plastic Naugahyde covering for use as a facing for hard surfaces in trains is in production according to an announcement made by the United States Rubber Company, New York 20.

The covering has a tough special backing which gives it stability in hanging. It can be applied with conventional adhesives on most hard surfaces. It has a smooth, fine textured grain and is resistant to abrasion, scuffing and gouging. This product will not become brittle or chip, retains its color and texture, and can be washed with soap and water.

The product is made in 30-yd. rolls, 50 in. wide. It is sold in 12 colors, including seven popular pastel shades and five deep tones. Special grains and colors are available on a made-to-order basis.



Instrument for Testing Insulating Materials

An instrument for electrical testing of insulating materials, the Current Limited High-Potential Tester, has been announced by the Special Products Division of the General Electric's Apparatus Department.

Developed by G. E. General Engineering and Consulting Laboratory, the instrument is designed to aid electrical manufacturing plants and service shops in testing insulation of electrical components and assemblies such as coils, relays, motors, and appliances. Special applications of the instrument have been made for detecting flaws in surface coatings of paint, lacquer, and sheet materials of a non-conducting nature.

The output current of the tester is limited to a value below the maximum value which an operator can let go if he should accidentally come in contact with the test probes. The low value of output current also assures non-destructive testing.

An indicating meter measures crest value of voltage on samples tested regardless of wave shape, internal voltage drop, or variation in line voltage. Faults are indicated by a glow lamp on the panel.

The indicating instrument reads the voltage across the equipment being tested and the measurement is not affected by impedance drops in the internal circuit of the tester. Overloading the tester does

(*Continued on page 108*)

"Tailor-made"

Esso Andok B

a better lubricant for better protection

THE IDEAL LUBRICANT—for all traction motor armature bearings... it has successfully performed in many anti-friction bearings in auxiliary equipment on passenger cars and locomotives.

ANDOK B GIVES 3-WAY SERVICE *when properly used* for important traction motor armature bearings:

1. Avoids overgreasing.
2. Avoids undergreasing.
3. Helps prevent introduction of dirt into bearings.

Bearings lubricated with famous Andok B can be completely sealed after overhaul... should run under ordinary use for 300,000 miles without further attention. For high-quality, long-lasting lubrication protection that saves on maintenance costs... specify Andok B!

BACKED BY CONSTANT RESEARCH—continuing tests *in the lab* and *on the road* make certain that Andok B keeps pace with progress and latest railroad lubrication needs.

BACKED BY CONSTANT FOLLOW-UP—on-the-job check-ups by Esso Sales Engineers watch the dependable performance of Esso Railroad fuel and lubricants. Be sure to call on Esso for any railroad fuel or lubricating problems.

The Sign of QUALITY — Esso — The Symbol of SERVICE

RAILROAD PRODUCTS

SOLD IN: Maine, N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Penna., Del., Md., D. C., Va., W. Va., N. C., S. C., Tenn., Ark., La.

ESSO STANDARD OIL COMPANY — Boston, Mass. — New York, N. Y. — Elizabeth, N. J. — Philadelphia, Pa. — Baltimore, Md. — Richmond, Va. — Charleston, W. Va. — Charlotte, N. C. — Columbia, S. C. Memphis, Tenn. — New Orleans, La.

NEWS

A.A.R. Mechanical Division Circulars

"Home for Repairs" Notation Omitted

An A.A.R. Mechanical Division circular, dated December 13, calls attention to unnecessary delays to damaged cars moving homeward for repairs because defect cards attached fail to carry the notation "Home for Repairs", as specified in Interchange Rule 4. In such cases, it is frequently necessary for the receiving road to shop the car and see if all existing damage is fully covered by the items listed on the defect cards. Invariably, additional unconcealed associated damage is found to exist, and the car is delayed while steps are taken to procure additional defect-card protection from the delivering line or from the road which issued the defect cards attached to the car.

Where the damage is slight and can easily be fully covered by a defect card, it is not necessary to include this notation. However, where the damage is more or less extensive and it cannot readily be determined that all delivering line defects are fully covered, it is then advisable to include the notation "Home for Repairs" on the defect card.

In the interest of reducing delays at interchange points, the circular urges that all forces authorized to issue defect cards be instructed to place this notation on cards where necessary.

Three Roller Bearing Lubricants Approved

In a recent circular, the following were approved as of December 13, 1950, by the Committee on Lubrication of Cars and Locomotives for lubricating the journal roller bearings of passenger equipment cars which move in interchange service: Lubrico M-1, special, Master Lubricants Company; H-927 non-fluid oil, New York and New Jersey Lubricant Company; No. 979 roller bearing grease, Texas Company.

This subject is receiving further study by the Committee on Lubrication of Cars and Locomotives.

Road Service Tests of Laudig Bearings

The A.A.R. Mechanical Division has recently authorized service tests of 100 cars equipped with Laudig iron-back journal bearings in interchange service. In order that full benefits from these tests may be realized, detailed instructions have been given regarding application of the bearings, condition of wedges and box roofs, bearing marks, stenciling and records.

The A.A.R. circular pertaining to Laudig bearings, dated November 30, lists six cars on the Pennsylvania and ten cars on the New York Central as already equipped with these bearings, other installations being scheduled for cars of the Baltimore & Ohio; Deleware, Lackawanna & Western; Denver & Rio Grande Western; and Norfolk & Western. The circular requested prompt return of any test bearings which develop defects to specified officers on the individual roads. Associated axles with journals damaged by contact with the iron back of the Laudig bearings are also to be returned, as this type of information is specifically desired.

Electrical Section Elects Officers

The Electrical Section, Engineering Division, Association of American Railroads, has announced its officers for 1951, including three new members of the Committee of Direction, elected for a three-year term.

The present slate of officers is as follows: chairman—H. F. Finnemore, chief electrical engineer, Canadian National, Montreal, Canada; vice-chairman—C. A. Williamson, electrical engineer, Texas & New Orleans, Houston, Tex.; secretary—N. D.

SELECTED MOTIVE POWER AND CAR PERFORMANCE STATISTICS

Freight Service (Data from I. C. C. M-211 and M-240)

Item No.		Month of September 1950	Month of September 1949	Nine months ended with September 1950	Nine months ended with September 1949
3	Road locomotive miles (000) (M-211):				
3-05	Total, steam	30,717	29,134	256,502	303,130
3-06	Total, Diesel-electric	18,492	13,030	152,690	109,390
3-07	Total, electric	859	726	7,386	7,297
3-04	Total, locomotive-miles	50,075	42,896	416,624	419,830
4	Car-miles (000,000) (M-211):				
4-03	Loaded, total	1,792	1,462	14,320	13,478
4-06	Empty, total	885	764	7,518	7,737
6	Gross ton-miles-cars, contents and cabooses (000,000) (M-211):				
6-01	Total in coal-burning steam locomotive trains	53,690	45,466	425,168	482,464
6-02	Total in oil-burning steam locomotive trains	14,299	14,085	113,127	133,532
6-03	Total in Diesel-electric locomotive trains	53,419	37,468	432,902	313,484
6-04	Total in electric locomotive trains	2,338	1,918	19,578	19,694
6-06	Total in all trains	123,775	98,959	990,984	949,262
10	Averages per train-mile (excluding light trains) (M-211):				
10-01	Locomotive-miles (principal and helper)	1.05	1.05	1.05	1.06
10-02	Loaded freight car-miles	40.1	38.1	38.4	36.1
10-03	Empty freight car-miles	19.8	19.9	20.2	20.8
10-04	Total freight car-miles (excluding caboose)	59.9	58.0	58.6	56.95
10-05	Gross ton-miles (excluding locomotive and tender) (000)	2,769	2,578	2,660	2,549
10-06	Net ton-miles (000)	1,296	1,152	1,211	1,14
12	Net ton-miles per loaded car-mile (M-211)	32.3	30.2	31.5	31.8
13	Car-mile ratios (M-211)	73.4	75.1	72.5	71.4
13-03	Per cent loaded of total freight car-miles	66.9	65.7	65.6	63.5
14	Averages per train hour (M-211):				
14-01	Train miles	16.7	17.0	16.9	16.9
14-02	Gross ton-miles (excluding locomotive and tender) (000)	45,555	43,178	44,422	42,411
14	Car-miles per freight car day (M-240):				
14-01	Serviceable	48.8	40.7	44.7	42.2
14-02	All	46.1	38.1	41.7	39.8
15	Average net ton-miles per freight car-day (000) (M-240)	998	756	862	804
17	Per cent of home cars of total freight cars on the line (M-240)	35.8	49.7	42.4	50.4

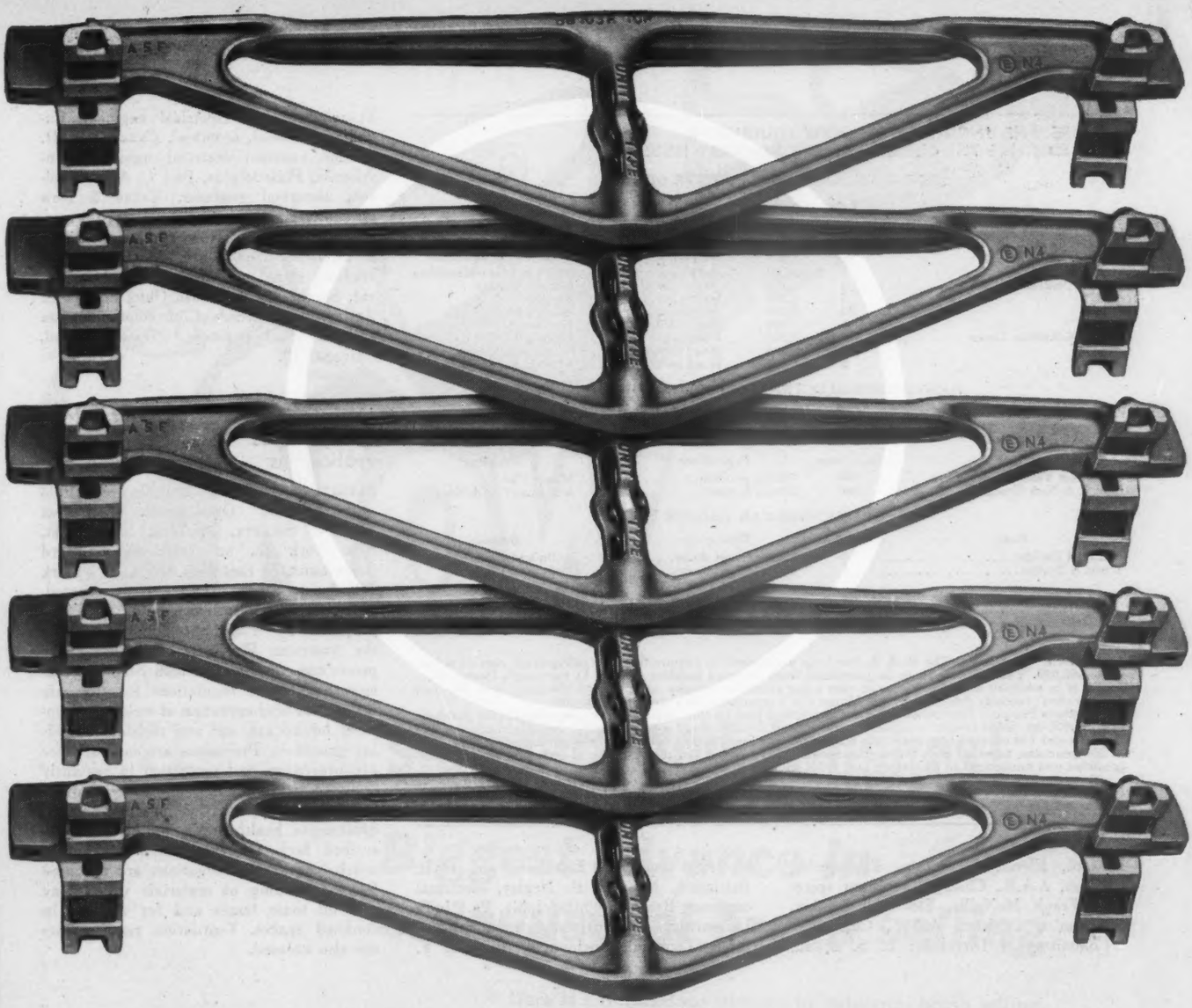
Passenger Service (Data from I. C. C. M-213)

3	Road motive-power miles (000):				
3-05	Steam	11,913	14,088	105,280	144,218
3-06	Diesel-electric	15,052	12,863	130,236	112,416
3-07	Electric	1,602	1,559	14,409	14,938
3-04	Total	28,568	28,509	249,926	271,685
4	Passenger-train car-miles:				
4-08	Total in all locomotive-propelled trains	297,578	272,679	2,408,620	2,538,835
4-09	Total in coal-burning steam locomotive trains	63,492	73,790	541,704	755,860
4-10	Total in oil-burning steam locomotive trains	38,481	41,672	332,448	401,031
4-11	Total in Diesel-electric locomotive trains	160,230	140,195	1,379,438	1,218,804
12	Total car-miles per train-miles	9.64	9.37	9.44	9.16

Yard Service (Data from I. C. C. M-215)

1	Freight yard switching locomotive-hours (000):				
1-01	Steam, coal-burning	1,457	1,464	12,689	16,425
1-02	Steam, oil-burning	273	240	2,180	2,496
1-03	Diesel-electric[1]	2,659	2,066	22,017	17,688
1-06	Total	4,419	3,796	37,129	36,845
2	Passenger yard switching hours (000):				
2-01	Steam, coal-burning	49	76	527	839
2-02	Steam, oil-burning	14	14	119	142
2-03	Diesel-electric[1]	234	212	2,037	1,858
2-06	Total	332	336	2,988	3,154
3	Hours per yard locomotive day:				
3-01	Steam	8.7	7.3	7.9	8.3
3-02	Diesel-electric	17.9	17.3	17.3	17.4
3-05	Serviceable	14.7	13.3	14.0	13.4
3-06	All locomotives (serviceable, unserviceable and stored)	12.7	10.8	11.8	11.2
4	Yard and train-switching locomotive-miles per 100 loaded freight car-miles	1.71	1.80	1.79	1.89
5	Yard and train-switching locomotive-miles per 100 passenger train car-miles (with locomotives)	0.74	0.77	0.77	0.77

[1] Excludes B and trailing A units.



Nothing could be Simpler, or Better, than this One-Piece Cast-Steel Beam

Stronger, lighter, one-piece construction makes A.S.F. Cast-Steel Unit Brake Beams ideal for all freight equipment. Heads are permanent, integral parts. They do not depend upon laps, welds, joints, or rivets for rigidity and proper alignment.

Today, after more than three years' use, there's not a single case on record of structural failure or of maintenance due to normal wear. Want more facts about these money-saving, long-lasting brake beams? Ask your A.S.F. Representative.

A.A.R. Approved. Certificate No. 54.

AMERICAN STEEL FOUNDRIES

MINT MARK OF ○ FINE PRODUCTS

ORDERS AND INQUIRIES FOR NEW EQUIPMENT PLACED SINCE THE CLOSING OF THE JANUARY ISSUE

DIESEL-ELECTRIC LOCOMOTIVE ORDERS

Road	No. of units	Horsepower	Service	Builder
Central of New Jersey	14[1]	1,600	General utility	Alco-G. E.
	1	1,000	Road switch	Alco-G. E.
	9	1,200	Switching	Electro-Motive
	7	1,200	Switching	Baldwin-Lima-Hamilton
Illinois Central	4	2,250	Passenger	Electro-Motive
	3	1,500	Switching	Electro-Motive
	35	1,200	Switching	Electro-Motive
	2	600	Switching	Electro-Motive
Missouri-Kansas-Texas	5	2,250	Passenger	Electro-Motive
	4	1,600	Road switch	Fairbanks, Morse
	2	1,600	Road switch	Alco-G. E.

GAS-TURBINE-ELECTRIC LOCOMOTIVE ORDERS

Union Pacific	10[2]	4,500	Freight	General Electric

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Cuyahoga Valley	100[3]	70-ton gondola	Magor Car
Lehigh & New England	500	50-ton hopper	American Car & Fdry.

PASSENGER-CAR ORDERS

Road	No of cars	Type of car	Builder
Missouri Pacific	4	Planetarium dome	Pullman-Standard
Texas & Pacific	1	Planetarium dome	Pullman-Standard

[1] Fall delivery expected.
[2] See page 72 of the January issue for a brief description of these locomotives.
[3] Delivery scheduled for July.

NOTES:

Bangor & Aroostook.—The B. & A. has been authorized to acquire 500 new refrigerator cars at a cost of $4,500,000. This equipment, to be purchased from contract builders or built at the road's Derby, Me., shops, is in addition to 500 refrigerator cars being rebuilt at Derby at a $1,500,000 cost, and 300 box "heater cars" recently delivered by the Magor Car Corporation at a cost of $2,100,000.

Northern Pacific.—Northern Pacific has announced that its 1951 improvement program calls for purchase of six 6,000-hp. diesel freight locomotives and three 1,500-hp. diesel road-switchers, the construction of 500 box cars and 100 covered hoppers at the company's Brainerd, Minn., shops, and the purchase from suppliers of 250 gondolas, together with the continuance of heavy repair and maintenance of cars. The order for 250 gondolas was announced in the December, 1950, issue.

Texas & Pacific.—The T. & P. has been authorized to purchase 34 diesel-electric locomotive units, as follows: Six 3-unit 4,500-hp., four 2-unit 3,000-hp. and one 1,500-hp. freight locomotives; two 1,500-hp. road-switching units and five 1,200-hp. switching units.

Howard, Electrical Section, Engineering Division, A.A.R., Chicago; assistant secretary—Frank McNellis, Electrical Section, Engineering Division, A.A.R., Chicago.

Committee of Direction; L. S. Billau, electrical engineer, Baltimore and Ohio, Baltimore, Md.; S. R. Negley, electrical engineer, Reading, Philadelphia, Pa.; John Leisenring, electrical superintendent, Illinois Terminal, Springfield, Ill.; H. F. Finnemore, chief electrical engineer, Canadian National, Montreal, Canada; K. H. Gordon, assistant electrical engineer, Pennsylvania, Philadelphia, Pa.; C. A. Williamson, electrical engineer, Texas & New Orleans, Houston, Tex.; H. F. Brown, electrical engineer, New York, New Haven & Hartford, New Haven, Conn.; H. A. Hudson, signal and electrical superintendent, Southern, Cincinnati, Ohio, and P. B. Burley, superintendent of communication and electrical engineer, Illinois Central, Chicago, Ill.

Miscellaneous Publications

SAFETY IN ELECTRIC AND GAS WELDING AND CUTTING OPERATIONS. AMERICAN WELDING SOCIETY, 33 West 39th Street, New York 18, or American Standard Association, 70 East 45th Street, New York 17. 42 pages, 6 in. by 9 in., paper covered. Price, 50 cents. American Standard Z49.1, prepared by a committee sponsored by the American Welding Society under the procedures of the American Standard Association, covers regulations for the safe installation and operation of welding equipment for all arc, gas and resistance welding processes. Provisions are included for fire prevention and protection in regularly assigned welding areas as well as in other locations. Eye protection and clothing requirements, health protection, etc., are prescribed both for the welder and other nearby workers. Precautions are specified for the welding of materials which may give off toxic fumes and for welding in confined spaces. Ventilation requirements are also stressed.

SUPPLY TRADE NOTES

BALDWIN-LIMA-HAMILTON CORPORATION.—*George H. Lynn*, who has been appointed general sales manager of the Hamilton division of the Baldwin-Lima-Hamilton Corporation, as announced in the January issue, joined the Lima-Hamilton Corporation in 1947 as western district manager in Chicago for the Niles tool works division and the Hooven, Owens, Rentschler division. Prior to joining Lima-Hamilton he was with the sales department of the Westinghouse Electric Corporation from 1933 to 1939. He next became eastern representative for the Axelson Manufacturing Company of Los Angeles, Cal., connected with the sales department of the lathe division. At the time Mr. Lynn left to join Lima-Hamilton he was special assistant to the president of the Los Angeles company.

—*John D. Dickinson*, formerly manager of locomotive sales of the Lima-Hamilton Corporation, at New York, has been appointed assistant district manager of the New York district office of the successor Baldwin-Lima Hamilton Corporation. Mr. Dickinson has been associated with Lima-Hamilton since 1927.

J. D. Dickinson

SHIPPERS' CAR LINE CORPORATION.—*Harry J. Leddy* has been elected executive vice-president of the Shippers' Car Line Corporation, subsidiary of the American Car & Foundry Co. *John B. Davenport* has been named vice-president in charge of sales.

◆

MACLEAN-FOGG LOCK NUT COMPANY.—*Ernest G. Doke*, assistant to the president, and *Joseph J. Murphy*, manager of sales, of the MacLean-Fogg Lock Nut Company have been named vice-presidents, with offices as before, in Chicago.

◆

CANADIAN RAILROAD SERVICE COMPANY.—*Joseph V. Condon* has been appointed assistant to Vice-President H. V. Gigandet of the Canadian Railroad Service Company, a unit of the Union Carbide & Carbon Corp., with headquarters at Toronto, Ont. Mr. Condon's railroad experience started with the Canadian National in 1928. He

(*Continued on page 98*)

NATIONAL standardized brushes!

TRADE-MARK

Biggest advance in 50 years of industrial brush selling

● Here is a tremendous advance in industrial brush selling. National Carbon has set up a list of diesel-electric locomotive brushes — for generators, traction motors and auxiliary equipment — which effectively covers the field. These brushes are the best ever made for this equipment. They will give you top performance. And you can get them at a *low, flat* price — regardless of quantity — so long as you order at least one box of brushes. You get the brushes quickly. They are kept in stock. Finally, you get the brushes in a sturdy, durable box. You get *better brushes*...at a *better price*...in a *better package.*

NATIONAL CARBON DIVISION
Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

Please send me complete information on National Carbon's new brush-standardization listings.

*Name*_____

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The term "National" is a registered trade-mark of

NATIONAL CARBON DIVISION
UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street, New York 17, N. Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

In Canada: National Carbon, Ltd., Toronto 4

(*Continued from page 94*)
became associated with Canadian Railroad Service in 1941 and was supervisor of maintenance of way at thee time of his appointment as assistant to vice-president.

◆

JOSEPH T. RYERSON & SON.—*Charles L. Hardy,* formerly assistant to the president, has been elected president of Joseph T. Ryerson & Son, to succeed *Everett D. Graff,* who has become chairman of the executive committee. *Thomas Z. Hayward,* formerly general manager of sales for the 13 Ryerson steel service plants, has been elected vice-president in charge of sales.

◆

GENERAL ELECTRIC COMPANY.—*Ralph J. Cordiner,* executive vice-president of the General Electric Company since 1949, has been elected president to succeed *Charles E. Wilson,* recently named chairman of the Defense Mobilization Board.

Mr Cordiner has been associated with G.E. for 24 years. During that period he

R. J. Cordiner

served as manager of five of the company's departments, and had been executive vice-president since 1949. He has been continuously connected with the electrical industry since his undergraduate days at Whitman College in Walla Walla, Wash., his birthplace. His first position was on a part-time basis with the Pacific Power & Light Co. In 1922 he was made commercial manager of a division of Pacific Power & Light. In less than a year he was offered a position with the Edison General Electric Appliance Company with headquarters in Portland Ore. Five years later he became northwest manager there and in 1930 moved to San Francisco, Cal., to become Pacific Coast division manager. When the heating device section of Edison General Electric Appliance was transferred from Chicago and consolidated with G. E.'s appliance and merchandise department at Brideport, Conn., in 1932, Mr. Cordiner went with the section as manager and chairman of the management committee. Two years later he was appointed assistant manager of appliance sales and in 1935 became manager of the radio division. A year later he was promoted to assistant manager of the appliance and merchandise department and in January, 1938, to manager of the department. In 1942 Mr. Cordiner entered government service as director general of war production scheduling and vice-chairman of the War Production Board. He rejoined G.E. as assistant to the president in 1943 and was elected vice-president in 1945.

◆

SAFETY CAR HEATING & LIGHTING CO.—*Henry A. Sperry* has been appointed sales representative in the St. Louis, Mo., office

H. A. Sperry

of the Safety Car Heating & Lighting Co. Mr. Sperry was previously in the company's engineering department at New Haven, Conn.

◆

STANDARD RAILWAY EQUIPMENT COMPANY.—*J. E. Vaughn* has been elected vice-president in charge of sales of the Standard Railway Equipment Manufacturing Company, with jurisdiction over sales in the United States and Canada. *S. L. Beymer* has been elected vice-president and executive assistant to the president.

◆

UNION ASBESTOS & RUBBER CO.—*A. F. O'Connor* has been appointed manager of the "Equipco" hand brake department of the Union Asbestos & Rubber Co. Mr. O'Connor was formerly sales manager. In his new position he will be in charge of sales, product development, engineering and manufacturing. This department will embrace all metallic items for railroad equipment, except "Equipco" refrigerator car specialties.

◆

COOPER - BESSEMER CORPORATION. — *Charles G. Cooper,* manager of the Washington, D. C., office of Cooper-Bessemer, has been elected a vice-president.

◆

AJAX-CONSOLIDATED COMPANY.—*R. L. Clark* has been appointed sales engineer for the Ajax-Consolidated Company, with headquarters in the First National Bank building, St. Paul, Minn.

◆

CHERRY RIVET COMPANY, DIVISION OF TOWNSEND COMPANY.—*F. R. Dickenson,* president of the Townsend Company, has announced completion of a merger of his firm and the Cherry Rivet Company of Los Angeles, Cal. The latter will operate as the Cherry River Company, division of Townsend Company. *William B. Hubbard,* former president of Cherry Rivet, has been elected to the Townsend board of directors and will be managing director of the Cherry Division. The merger was effected by an exchange of 6½ shares of Cherry Rivet stock for each share of Townsend.

◆

UNITED STATES RUBBER COMPANY.—*Edwin D. Meade,* formerly manager of western railway sales of the United States Rubber Company, has been appointed district sales manager, Chicago branch, succeeding *Joseph A. Conlon,* who has been appointed manager of allied sales for the mechanical goods division, at New York.

Mr. Meade joined U. S. Rubber as a clerk in the New York branch in 1935. He entered mechanical goods sales a year later and, in 1941, became a special representative of the war products division, at Washington, D. C. He was transferred to Chicago as manager of western railway sales in 1947. Mr. Conlon joined U. S. Rubber in June, 1930, as a salesman in the Los Angeles, Calif., branch. He advanced through various sales and merchandising positions until 1945, when he was appointed assistant district sales manager of the mechanical goods division's Chicago branch. In September, 1949, he became district sales manager at Chicago. The United States Rubber Company has purchased from the Esso Standard Oil Company the latter's Buna-N synthetic rubber plant in Baton Rouge, La. The plant will be operated by the Naugatuck chemical division of the rubber company, which will continue to market Buna-N rubber under the trade name Paracril.

◆

CULLEN-FRIESTEDT COMPANY.—*H. M. McFarlane* has been appointed sales manager

H. M. McFarlane

of the Cullen-Friestedt Company at Chicago. Mr. McFarlane is president of the National Railway Appliances Association.

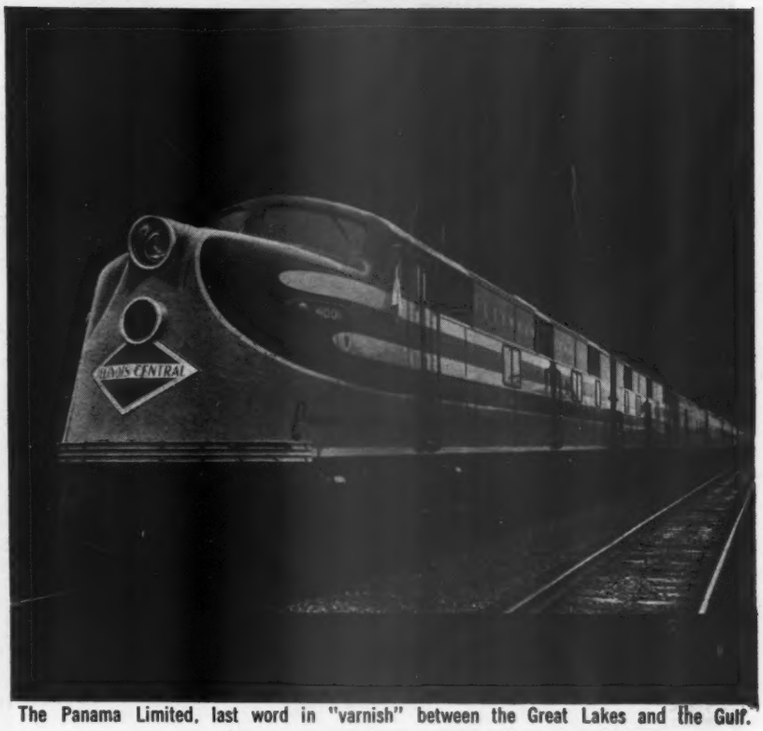
◆

WESTINGHOUSE ELECTRIC CORPORATION.—*A. M. Harrison* has been appointed manager of the DC Engineering Department of the Transportation and Generator Division of the Westinghouse Electric Corporation at East Pittsburgh, Pa. Mr. Harrison was

WELCOME

ILLINOIS CENTRAL

TO THE CENTURY CLUB



The Panama Limited, last word in "varnish" between the Great Lakes and the Gulf.

A salute to the Illinois Central from the makers of

PENNSALT MAINTENANCE CLEANERS

This year marks the centennial celebration of the Main Line of Mid-America. Pennsalt, itself just turned 100, congratulates the Illinois Central on 100 years of successful railroading.

Progressive railroading, too! Progressive in fast, dependable freight service, such as that rendered Pennsalt at its new Calvert City, Ky., plant. Progressive in passenger service, typified by the all-Pullman Panama Limited.

Progressive in maintenance, too, where Pennsalt cleaning compounds have been selected for cleaning steam locomotive frames, trucks and running gear . . . as well as Diesel engine blocks and trucks.

Illinois Central has found that Pennsalt Cleaners give fast, efficient cleaning on a wide variety of parts. Solutions last longer, and, because Pennsalt alkaline cleaners are virtually anhydrous, they can be used in lower concentrations.

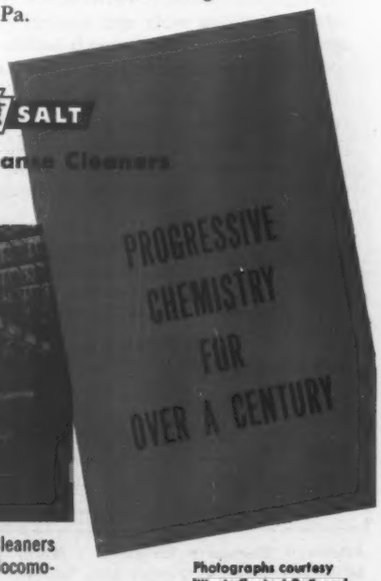
Not only on the Illinois Central, but on many other major roads Pennsalt Cleaners are delivering that extra "something" in cleaning efficiency. Your local Pennsalt representative will be glad to study your maintenance cleaning operations, and help set up tests to prove the advantages of Pennsalt Cleaners. Write: Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa.

PENN SALT

Railroad Maintenance Cleaners

One of the Illinois Central fast freights which speed merchandise from the head to the toe of America.

Shops at Paducah, Ky., where Pennsalt Cleaners give fast efficient removal of soil, keep locomotives on the high iron.



Photographs courtesy Illinois Central Railroad

previously manager of the d.c. machine section of the DC Engineering Department.

◆

CUMMINS ENGINE COMPANY.—*Charles J. Wilhite* has been appointed acting northwest regional manager of the Cummins

C. J. Wilhite

Engine Company, with headquarters at 809-810 Security building, Seattle, Wash. *Ralph J. Shields* succeeds Mr. Wilhite in the position of northwest regional service representative.

◆

HENRY DISSTON & SONS.—*L. W. Jander* has been appointed sales manager of the industrial division of Henry Disston &

L. W. Jander

Sons. Mr. Jander succeeds *J. F. Wilkinson*, resigned. Mr. Jander has been in charge of eastern sales division operations since 1947.

◆

UNITED STATES STEEL CORPORATION.—A new steel plant, which will have the capacity to produce 1,800,000 ingot tons of steel a year for national defense and essential civilian uses, will be constructed near Morrisville, Pa., by the United States Steel Corporation. The plant, to be named the Fairless Works in honor of the company's president, Benjamin F. Fairless, will produce a wide range of finished products, including bars, standard steel pipe, wire rods, hot and cold rolled sheets and strip, and tin plate. Construction is ex-

BIDDLE Instrument News

NUMBER 3 OF A SERIES

JAMES G. BIDDLE CO., 1316 ARCH ST.
PHILADELPHIA 7, PA.
ELECTRICAL TESTING • SPEED MEASURING INSTRUMENTS • LABORATORY & SCIENTIFIC EQUIPMENT

TRACTION MOTOR ARMATURES TESTED WITH CONVENIENT PORTABLE KIT

The portable test kit shown here, in use on the Santa Fe Railway, includes a Ducter Low Resistance Ohmmeter, a Biddle Power supply and a Meg type of Megger Rectifier-Operated Insulation tester. The bar-to-bar test on the armature is being made with the Ducter, using duplex hand spikes having a current and potential spike in each handle. In general, bar-to-bar tests are more for the purpose of equalizing the resistances than for measuring their exact values.

The Ducter Low Resistance Ohmmeter is completely discussed in our Bulletin 24-25-X and its operation and application are clearly described in our Instruction Manual 23J25-X. If you send us a request, we shall promptly mail you both of these booklets. Reading them will reveal why so many railway electrical men rely on rugged, simple-to-use Ducter equipment for accurate measurements down to a millionth of an ohm.

Photo courtesy Santa Fe Railway

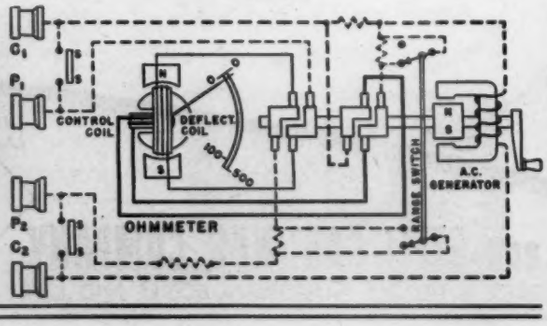
We are constantly publishing new technical bulletins on Biddle Instruments. A complete list of our latest bulletins will be mailed you on request, so that you may check it to bring your files up-to-date.

RAILROAD MEN SAY GROUND TESTING IS SIMPLIFIED

with the New CVM Type Megger® Ground Tester

Introduced in 1950, the CVM Type Megger Ground Tester is becoming a popular instrument with railroad signal and electrical maintenance engineers. Modern designing makes possible a lower cost. Weight is only 6 pounds. Dimensions are 7½" x 5" x 5¾". It is a completely self-contained test set with its own generator for supplying test current—no dependence on batteries or other current supply.

Here is an easy-to-use field instrument for determining if the resistance to earth of man-made grounds is sufficiently low to minimize dangers due to lightning. You can learn more about it by sending for Bulletin 25-80-X.



pected to begin early this coming spring and the structure is scheduled for completion by the end of 1952. The National Tube Company will operate the pipe producing portion of the new plant, while the remainder of the Fairless Works will be operated by the United States Steel Company.

◆

DUFF-NORTON MANUFACTURING COMPANY —*T. W. Krueger* has been appointed general sales manager of the Duff-Norton Manufacturing Company, Pittsburgh, Pa. Mr. Krueger, who joined Duff-Norton in 1947 as advertising and sales promotion manager, will continue to direct advertising and sales promotion activities.

PERSONAL MENTION

General

H. G. DUGAN, master mechanic of the Toledo Terminal at Toledo, Ohio, has been appointed superintendent of operations and motive power. The position of master mechanic has been abolished.

E. E. GLEASON, superintendent of motive power of the Western Pacific has had his title changed to chief mechanical officer.

E. T. CUYLER, assistant superintendent of motive power of the Western Pacific, has had his title changed to assistant chief mechanical officer.

IVAN S. GIBB has been appointed superintendent motive power and equipment of the Donora Southern at Donora, Pa.

JOHN E. MCLEOD, superintendent motive power of the Chesapeake & Ohio at Richmond, Va., has been appointed chief mechanical officer at Richmond. Mr. McLeod was born in Rockville, Conn. While attending McGill University at Montreal, Que., where he took a special course in railroad transportation, he worked summers as a special apprentice on the Cana-

J. E. McLeod

AN IMPORTANT CONTRIBUTION

COMMONWEALTH CAST STEEL UNDERFRAMES

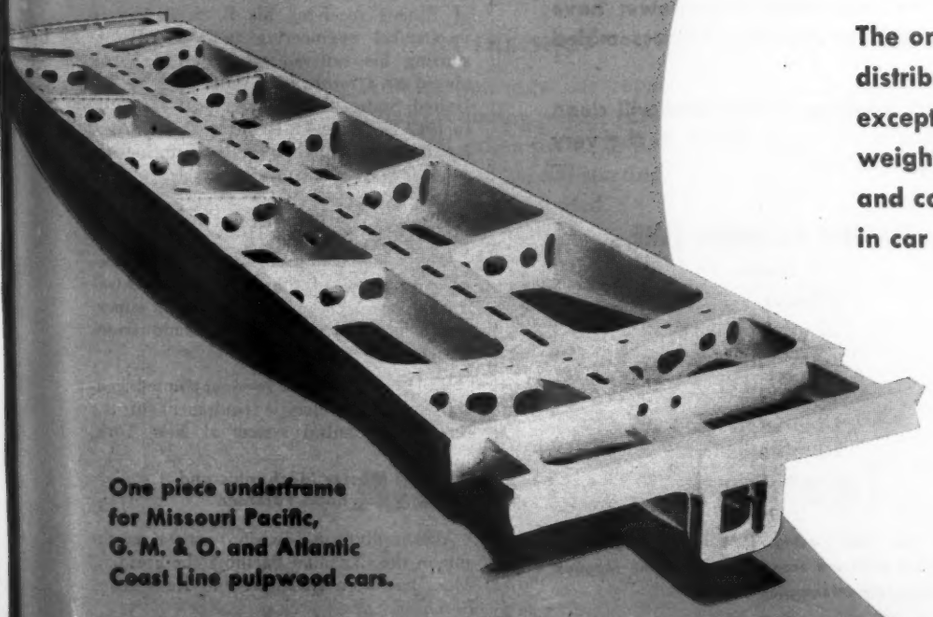
For the Large Freight Car Program

As part of the Defense Preparedness Program, America's railroads placed orders in 1950 for 2000 COMMONWEALTH One-Piece Cast Steel Underframes for flat cars, pulpwood cars and "special service" freight cars.

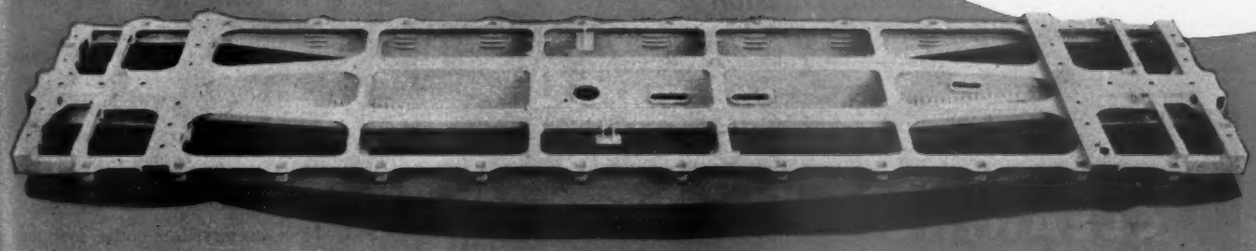
The one-piece construction, with metal distributed where it is needed most, provides exceptional strength without increase in weight, eliminating welded or riveted joints and connections, and saving manpower in car building.

COMMONWEALTH Underframes are practically indestructible. They assure increased availability of freight cars with longer service-life and greatly reduced upkeep costs.

Consult us about your requirements.



One piece underframe for Missouri Pacific, G. M. & O. and Atlantic Coast Line pulpwood cars.



One piece underframe for G. M. & O. and Union Pacific flat cars.

GENERAL STEEL CASTINGS

GRANITE CITY, ILL. • EDDYSTONE, PA.

dian Pacific. For five months he was a locomotive fireman in the employ of the New York, New Haven & Hartford. In February, 1918, he became a yard clerk on the New York, Chicago & St. Louis. After service in the U. S. Army Medical Corps during World War I, Mr. McLeod returned to the Nickel Plate as a special apprentice at Stony Island, Ill., working his way up to general enginehouse foreman in February, 1924. He became mechanical inspector of the Chesapeake & Ohio at Hunting, W. Va., in September, 1933, and subsequently served as assistant master mechanic at Stevens, Ky.; as assistant master mechanic at Peru, Ind., and as master mechanic at Columbus, Ohio. He was appointed superintendent motive power at Richmond on January 1, 1949.

E. R. HAUER, chief mechanical engineer for the Chesapeake & Ohio, the New York, Chicago & St. Louis, and the Erie, has been appointed assistant superintendent motive power, engineering, of the Chesapeake & Ohio, with headquarters at Richmond, Va. The position of chief mechanical engineer has been abolished.

S. A. SCHICKEDANZ, mechanical engineer of the Chicago & Eastern Illinois at Danville, Ill., has retired from service. Mr. Schickedanz was born on April 30, 1884, at Chenoa, Ill., and was educated at Pontiac (Ill.) high school and the University of Illinois receiving his B. S. degree in mechanical engineering in 1911. Before starting his railroad career he was employed as a mechanical draftsman by the United States Fuel Company at Danville. In 1912 he became a mechanical draftsman for the C. & E. I.; in 1915 chief draftsman, and in 1919 mechanical engineer.

Electrical

G. S. GLAIBER, general supervisor electric equipment of the New York Central System, has been appointed assistant superintendent of equipment, with headquarters as before at New York.

H. H. DUEHNE has been appointed general supervisor electric equipment of the New York Central system at New York.

Master Mechanics and Road Foremen

ALBERT BETTON, division master mechanic of the Canadian Pacific at Lethbridge, Alta., has been transferred to Revelstoke, B. C.

WILLIAM STEWART, master mechanic of the Saskatchewan district of the Canadian Pacific, has been appointed master mechanic of the Pacific region, with headquarters at Vancouver, B. C.

C. A. PEASE has been appointed assistant master mechanic on the New York Central, with headquarters at Toledo, Ohio.

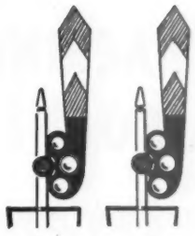
W. W. OSBORNE, general foreman, has been appointed master mechanic of the Norfolk division of the Virginian with headquarters as before at Victoria, Va.

F. G. NOSEWORTHY, locomotive foreman in the Winnipeg, Man., roundhouse of the Canadian Pacific, has been appointed divi-

Question: Just <u>where</u> does "Roller Freight" cut operating costs?

AT TERMINALS

Man-hours needed for terminal inspection are reduced 90% when freight trains are mounted on Timken® tapered roller bearings!



ON THE ROAD

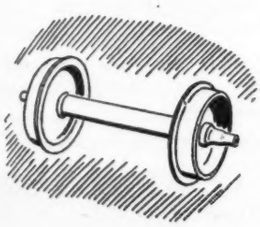
Expenses and delays due to "hot boxes" are practically eliminated by Timken bearings. Roller bearing design minimizes friction, permits better retention of lubricants. And there's no waste to "grab" during humping.

IN THE YARDS

Because "Roller Freight" cars travel faster and spend less time-out for repairs, more cars are available when you need them.

AT DESTINATIONS

Timken bearings cut starting resistance a tremendous 88% to make smoother starts and stops possible. Result: fewer damage claims!



IN THE SHOP

Timken bearings cut repair bills by reducing wear on draft gear and other parts. Impact damage from "serial starting" jolts can be eliminated.

ANYWHERE

You can schedule full-length trains all winter long with "Roller Freight"! Timken bearings reduce friction to a minimum, even in cold weather.

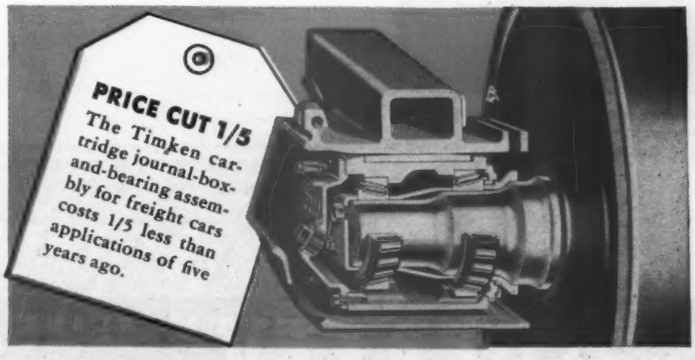
AN EDGE ON COMPETITION, TOO! Besides cutting your operating costs, "Roller Freight" will give you a decided edge on competition in your effort to get a bigger share of tomorrow's freight tonnage. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

Answer: All along the line!

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▱ BEARING TAKES RADIAL ◎ AND THRUST —◎— LOADS OR ANY COMBINATION —◎—

sion master mechanic of the Portage division of the C. P. R., with headquarters at Winnipeg, Man.

C. G. FOSTER, master mechanic of the Norfolk division of the Virginian at Victoria, Va., has been transferred to the position of master mechanic at Elmore, W. Va.

J. R. VANNORTWICK, acting terminal master mechanic of the Chicago, Burlington & Quincy, has been appointed terminal master mechanic at Chicago.

R. A. DAVIS has been appointed district master mechanic of the Canadian Pacific, with headquarters at Moose Jaw, Sask.

H. H. NIEMEYER has been appointed master mechanic of the Beardstown division of the Chicago, Burlington & Quincy, with headquarters at Beardstown, Ill.

ARTHUR BAYNHAM, division master mechanic of the Portage division of the Canadian Pacific at Winnipeg, Man., has been transferred to the position of division master mechanic at Lethbridge, Alta.

GEORGE H. NOWELL, master mechanic of the Canadian Pacific's Pacific region, with headquarters at Vancouver, B. C., has retired after 51 years of service with that road.

C. E. PLOTT, master mechanic of the Beardstown division of the Chicago, Burlington & Quincy at Beardstown, Ill., has retired.

FRANK J. SMITH has been appointed general foreman of the Atlantic Coast Line at Waycross, Ga.

WYTHE D. QUARLES, superintendent of terminals at the Atlantic Coast Line at Richmond, Va., has been appointed master mechanic at Waycross, Ga.

Shop and Enginehouse

E. H. WRIGHT has been appointed general foreman at the Englewood enginehouse of the New Yark Central at Chicago.

VAN WILLIAMS, JR., has been appointed general foreman of the Atlantic Coast Line at Montgomey, Ala.

D. J. BOURNE has been appointed general foreman at the Elkhart, Ind., enginehouse of the New York Central.

R. G. BENNETT, JR., master mechanic of the Virginian at Elmore, W. Va., has been appointed shop superintendent at Princeton, W. Va.

W. H. FOSTER, shop superintendent of the Virginia at Elmore, W. Va., has retired.

W. O. BRADLEY, general foreman at the Russell, Ky., car shop of the Chesapeake & Ohio, has been appointed assistant shop superintendent at Russell.

M. P. METZGER has been appointed general foreman of the New York Central at Englewood, Ill.

O. L. EASTON has been appointed general foreman, freight department, of the New York Central at Beech Grove, Ind.

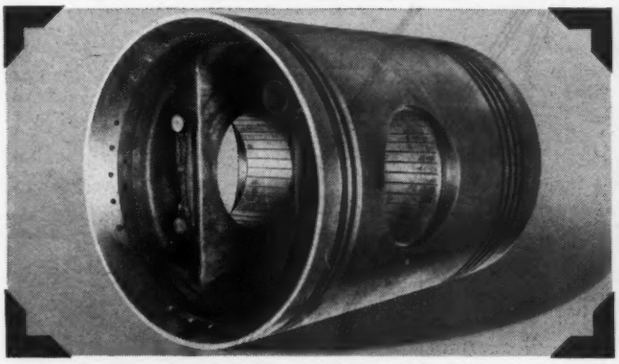
G. R. GIVIDEN has been appointed general foreman, passenger department, of New York Central at Beech Grove, Ind.

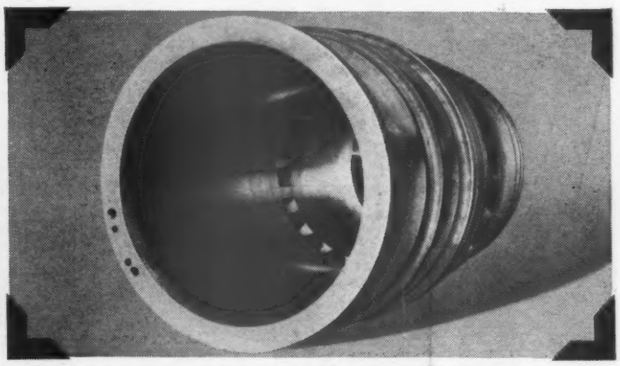
STANDARD ENGINEER'S REPORT

DATA

LUBRICANT RPM Delo Oil R.R.
UNIT Diesel Locomotive cylinder assembly
SERVICE Mountain Freight
LOCATION Transcontinental freight service on Moffat tunnel & Royal Gorge Routes
PERIOD In excess of 8 years
FIRM Denver & Rio Grande Western R.R.Co.

One million miles of service on cylinder liners and pistons





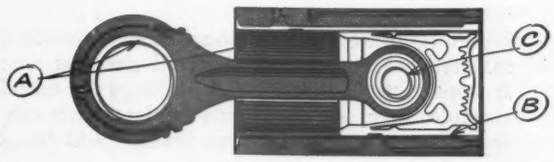
IN SERVICE APPROXIMATELY 1,000,000 MILES in Denver & Rio Grande Western Railroad diesel locomotive engines, this piston and cylinder liner were always lubricated with RPM DELO Oil R.R. At the end of that time wear measurements (inches) were only: Piston Skirt—0.001; Ring Grooves—No. 1—0.003 to 0.006, No. 2—0.002, No. 3 & 4—none; Cylinder liner (maximum diameter)—0.0095, (out of round)—0.002 to 0.004.

RPM DELO Oil R.R. has been the standard on the Denver & Rio Grande Western Railroad for over-the-road freight and passenger locomotives since their first power of this type was placed in service in January 1942. At the time this inspection was made approximately 49,563,104 miles had been traversed by the Rio Grande freight diesel fleet of 100 units and during that period only 77 cylinder liners had been scrapped for any reason. At that time many of the original pistons and cylinder liners were still in service and the average age of all these assemblies, including recently purchased power, was 4.7 years.

RPM DELO LUBRICATING OILS

TRADEMARK "RPM" REG. U.S. PAT. OFF.

How RPM DELO Oil R. R. prevents wear, corrosion, oxidation



A. Special additive provides metal-adhesion qualities...keeps oil on parts whether hot or cold, running or idle.

B. Anti-oxidant resists deterioration of oil and formation of lacquer...prevents ring-sticking. Detergent keeps parts clean... helps prevent scuffing of cylinder walls.

C. Special compounds stop corrosion of any bushings or bearing metals and foaming in crankcase.

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor handling them, write or call any of the companies listed below.

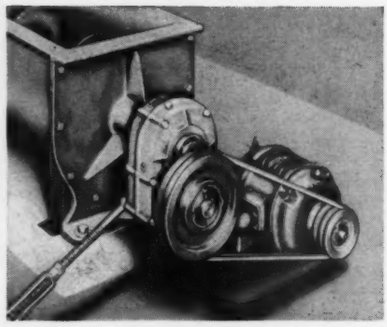
STANDARD OIL COMPANY OF CALIFORNIA • San Francisco
THE CALIFORNIA OIL COMPANY • Barber, N.J., Chicago, New Orleans
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA COMPANY • Denver, Colorado

(Continued from page 87)

not cause errors in the measurement of applied voltage and does not damage the tester.

The tester is enclosed in a metal cabinet with a convenient carrying handle. It operates from a power supply of 105 to 125 volts a.c. of 60 cycles. It is available in either single or dual range models. The single range model has an output of 0 to 3,200 volts, r.m.s. The dual range model has an 0 to 1,600-volt range in addition to the 0 to 3,200. For odd frequencies and higher voltages, special models can be made.

The primary circuit uses resistance and a potentiometer to supply an adjustable voltage to the primary of the transformer and to damp out line surges. Because of its current limiting feature, the instrument is approved for use without the usual interlocks, cages and safety barriers.



Shaft-Mounted Torque-Arm Reducer

Claimed to be the first shaft-mounted reduced designed for output speeds from 115 to 330 r.p.m., the illustrated single reduction unit is being produced by the Dodge Mfg. Company, Mishawaka, Ind., in four sizes to cover capacities up to 27 hp.

Ease and economy of installation of the unit are attributed to shaft mounting which eliminates engineering, cost of a foundation, flexible couplings, sliding base, and time consuming operation of lining up.

The device is locked securely to the driven shaft by means of two steel locking collars—one on each side of the reducer. It is anchored to the floor or any other fixed object by the torque-arm. While it can be driven through any V-belt drive, the designers recommend their Taper-Lock sheaves for facility either of installation or removal and for maximum efficiency of operation. Flat-belt drive can also be used.

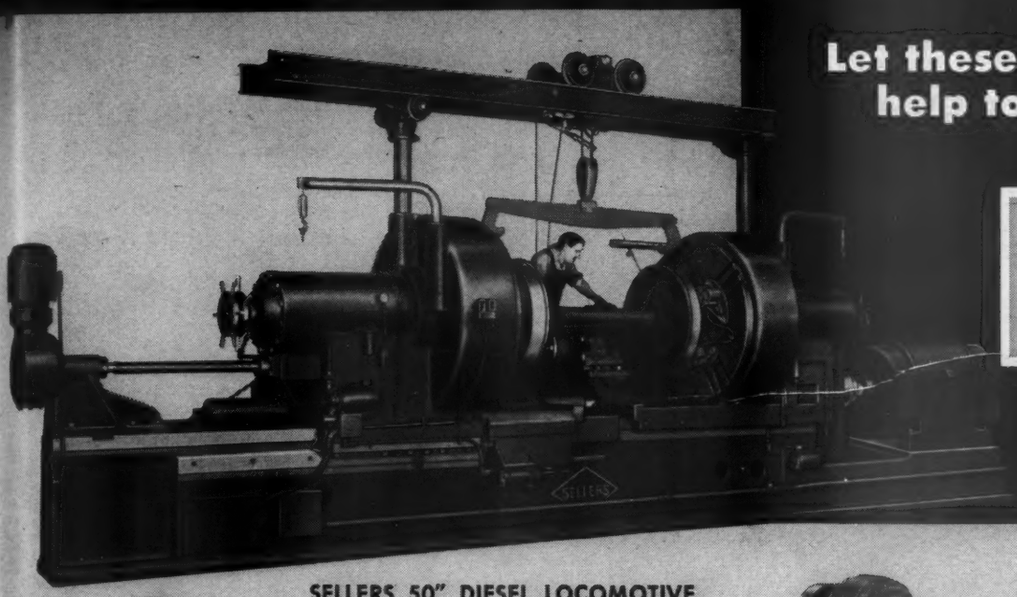
Any required output speed within the recommended range of 115 to 330 r.p.m. can be obtained with stock sheaves properly related in size. Variations of that speed are accomplished simply by changing sheave sizes.

Construction features include a machined cast iron housing, deep groove ball bearings, and helical steel gears which are shaved for quiet operation and heat treated. The unit is comparatively light in weight, the No. 12 size weighs but 49 lb.

Also provided is a backstop. Wherever required to prevent reversal of direction of

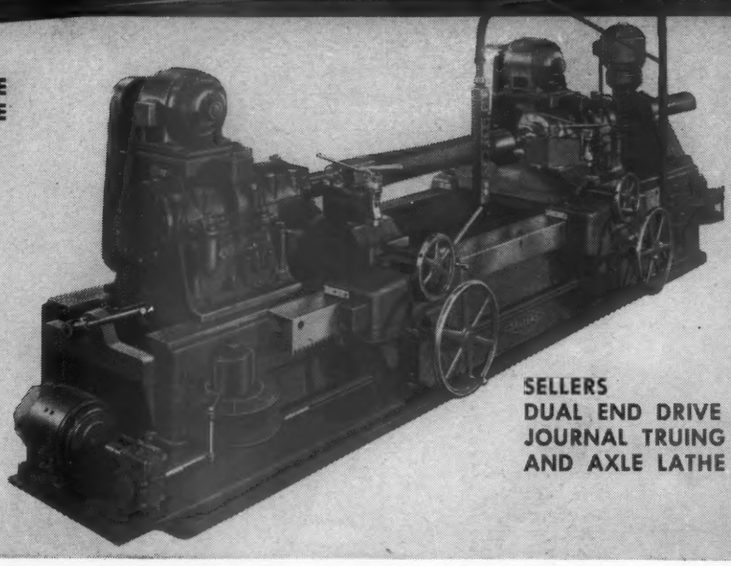
Let these modern machines help to reduce your costs

Faster, more economical production for all your diesel locomotive and car wheel and axle work



SELLERS 50" DIESEL LOCOMOTIVE AND CAR WHEEL LATHE

BETTS HYDRAULIC FEED DIESEL LOCOMOTIVE AND CAR WHEEL BORER
Patents Pending



SELLERS DUAL END DRIVE JOURNAL TRUING AND AXLE LATHE

Among Railroad Tools built by Consolidated are . . .

CAR WHEEL BORERS
DIESEL WHEEL BORERS
BURNISHING LATHES
TIRE MILLS
END DRIVE AXLE LATHES
CENTER DRIVE AXLE LATHES
JOURNAL TRUING LATHES
DRIVING WHEEL LATHES
CAR WHEEL LATHES
RADIUS LINK GRINDERS
PROFILE MILLING MACHINES
SLAB MILLING MACHINES
ROD MILLING MACHINES
CYLINDER BORING MACHINES
KEYWAY MILLING MACHINES
CRANK PLANERS
DRILL PRESSES
AND OTHERS

SELLERS 50" DIESEL LOCOMOTIVE AND CAR WHEEL LATHE turns diesel locomotive and car wheels from 28" to 50" tread diameter. Designed with speed range suitable for either carbide or high speed steel tools. Two mechanical speed changes in conjunction with a variable speed 75 H.P. motor provide speed ranges of approximately .9 to 3.6 R.P.M. and 5 to 20 R.P.M. of faceplate with instantaneous speed selection. Faceplates are recessed, with removable filler blocks, for turning diesel wheels, motor coach wheels and trailer wheels with roller bearings. As illustrated, this machine is arranged with four self-equalizing hydraulic drivers on each faceplate, insuring equalized pressure on the wheel rims.

BETTS HYDRAULIC FEED DIESEL LOCOMOTIVE AND CAR WHEEL BORER takes diesel locomotive wheels up to 48" tread diameter, passenger and freight car wheels down to 30" tread diameter. Hydraulically operated side head, for turning and facing hubs, has feed and rapid traverse vertically and horizontally with supplementary hand feed. Full automatic boring cycle from loaded start to stop supplemented by manual operation at any point in the automatic cycle. Speed range suitable for either carbide or high speed steel tools.

SELLERS DUAL END DRIVE JOURNAL TRUING AND AXLE LATHE for both new and reconditioning work, this machine turns and burnishes rough turned AAR car axles in sizes from 4¼" x 8" up to and including 6½" x 12", and turns and burnishes journals and collars on mounted car wheel sets up to and including 38" tread diameter. It is also available with greater swing for larger wheels. Designed with speed range suitable for carbide tools.

Full details covering any or all of these modern Consolidated machines will be furnished upon request. Let us show you how their labor-saving features not only can help to reduce your costs but also, by largely eliminating manual operations, encourage the operator to make full use of the higher production capacities of which these machines are capable.

BUILDERS OF HEAVY DUTY MACHINE TOOLS SINCE 1848

BETTS • BETTS-BRIDGEFORD • COLBURN • HILLES & JONES • MODERN • NEWTON • SELLERS

CONSOLIDATED MACHINE TOOLS

CONSOLIDATED
MACHINE TOOL CORPORATION

ROCHESTER 10, NEW YORK

load, it is easily installed on the input shaft within the reducer where it is sealed against dust and dirt.

Guarded Light

A lighting fixture which is protected against breakage and combines lighting efficiency with beauty has been made available by Strickley & Company, Los Angeles 5, Calif.

The light is designed for use in industrial plants and shops, and all places in which breakage creates a hazard. Simplicity of installing, relamping, cleaning and choice of finishes are features.

Standard opal glass is protected with cork gaskets and steel grill. All metal is non-ferrous except front and end grills which are rust-proofed. Open ends prevent accumulation of bugs and dirt. The 150-watt lamp is replaced by backing off one non-loseable screw. The unit is supplied in architectural bronze or brushed cadmium or old iron. The height is 13 in., the width 9 in. and the depth 5 in. Shipping weight is 6 lb.

General Purpose Driving Tool

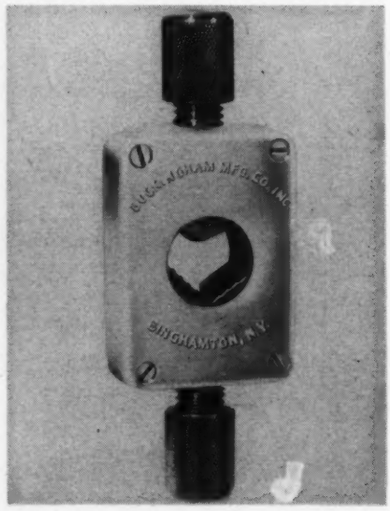
Named the Impakdriver, a new general purpose tool is now avaiable from the H. K. Porter, Inc., Somerville, Mass. The device is useful in repair, maintenance, installation and production work where screws, bolts or nuts must be turned.

With a twist in the desired direction and a few raps with a hammer, screws, bolts or nuts can be tightened or loosened easily and quickly. This alloy steel hand tool is constructed on a cam principle that translates the impact from a hammer's blow into an amount of torque.

Particularly useful for starting stubborn nuts, bolts or screws that are rusted or frozen on, the tool also provides an answer for working in hard-to-get-at places. For mechanics, machinists, repair men, maintenance men, the Impakdriver solves many

problems and saves tremendous amounts of time.

It is sold by itself or in sets with different combinations of bits and sockets for various sizes and types of screws, bolts and nuts.



Close Quarter Thread Restorer

The illustrated unit is suited for reconditioning closely spaced studs and bolts that are battered, distorted or rusted. Produced by Buckingham Manufacturing Company, Binghamton, N.Y., this product is added to a line of four other types of thread restorers to take care of all ASME and SAE standard threads from ¼- up to 4-in. diameter.

With a swing of only 2-5/16 in., this device works readily in close quarters, particularly on cylinder heads of automotive, marine diesel and steam engines, also on wheel lugs, spring hangers, actual shafts and pipe.

Its adjustable cutting jaws can be fitted by a simple twist of the handle to any male thread of ¼- to 1-in. root diameter, either right- or left-hand. The jaws may be engaged at the bottom of the threaded section, and turned out toward the top, leaving clean end threads in which nuts may be started and run down easily.

No die sets are required for interchange of size or type of thread. The tool is completely self contained and weighs only 1¼ lb.

One Quart Fire Extinguisher

The American LaFrance-Foamite Corporation, Elmira, N. Y., has designed and placed on the market a one-quart air-pressurized fire extinguisher. This unit discharges a vaporizing liquid fluid for extinguishing both flammable liquid and electrical type fires.

The device is aimed and operated like a gun with trigger-quick action. It hits

Now, ALL Railroads can put wheel mounting and demounting operations on a real production basis with new, modern W-S Wheel Mounting and Demounting Presses.

Incorporating outstanding design and construction features, these latest developments of W-S Engineers provide the fastest cycle of operation ever attained in this type of equipment, and they handle any type of wheels.

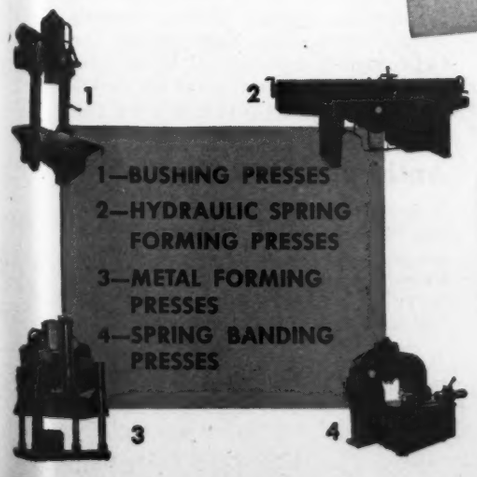
300 TON STRAIGHT THROUGH MOUNTING PRESS

MOUNT and DEMOUNT in Seconds with NEW W-S WHEEL PRESSES

Smashing time records daily, these New Watson-Stillman Speed Presses permit YOU to set your own floor-to-floor speed time—and this is only limited by your loading and unloading facilities.

Get the story today from one of the W-S Representatives listed below.

600 TON STRAIGHT THROUGH DEMOUNTING PRESS



WATSON-STILLMAN

HYDRAULIC MACHINERY DIVISION ESTABLISHED 1848

Factory and Main Office: ROSELLE, NEW JERSEY • Branch Office: CHICAGO, ILL.

Manufactured in Canada by CANADIAN VICKERS, Ltd., MONTREAL

REPRESENTATIVES

Chicago 4, Ill.....W. R. Walsh
Denver 2, Colo.....Overgard Machine Tool Co.
New York 17, N. Y.....Eastern Railway Supplies, Inc.
St. Paul 4, Minn.....Anderson Machine Tool Co.
San Francisco 5, Calif.....Overland Supply Co.
Washington 5, D. C.....Ralph Payne

9-K-12

the fire target accurately with no unnecessary loss of liquid. No pumping is required. Simply aim and squeeze the trigger with one hand.

This device is called the Alfco pressurized fire-gun and carries the inspection and approval label of Underwriters Laboratories. It is recharged by simply pouring in more vaporizing liquid and can be pressurized with any standard air chuck as commonly used in gasoline service stations, or it can be pressurized with any ordinary tire pump.

The unit is said to be ideal for protecting automobiles, motors, trucks, trailers, street and railroad cars and electrical equipment. It will stop small oil and grease fires from becoming big blazes.

Multiple-Alloy Plate Steel

The first of a new group of alloy steels to be known as T-steels is Carilloy T1, a multiple-alloy plate steel, which combines high strength with ductility and toughness, even at sub-zero temperatures, is available from the United States Steel Corporation's subsidiary, the Carnegie-Illinois Steel Corp., New York, N. Y.

With almost double the strength of high-strength, low-alloy steels and almost triple that of ordinary welding grade structural steels, the product promises to effect considerable savings in applications calling for heavy steel members of ½ in. thickness and up. It is designed to be at least two to three times as resistant to atmospheric corrosion as plain carbon steels.

This plate steel is furnished heat treated to a minimum yield strength of 100,000 lb. per sq. in. pressure. It maintains adequate toughness at this level of strength and is said to be suitable for application where high strength and good weldability are required.

Welding does not affect its properties adversely. If low-hydrogen type electrodes are used, Carilloy T1 is not susceptible to underbead cracking. Electrodes that will develop the full strength of the T1 basic metal are available.

No special equipment and procedures are required for fabrication. Bending or forming may be accomplished cold if sufficient power is available to overcome the high yield strength. If hot forming is necessary, the operation must be followed by heat treatment which involves liquid quenching and tempering after the hot forming operation.

The properties of this steel are obtained by blending multiple alloying elements, coupled with precision heat treatment. Carbon content is restricted to 0.18 maximum to promote ease of welding and gas cutting.

Antiseptic Dust Control

A time-saving, dust-control method of floor care through use of Antiseptic Westone has been announced by the West Disinfecting Company, Long Island City 1, N. Y.

It is claimed that the utilization of this

TIMKEN · FAFNIR · S.K.F. · HYATT

LUBRIKO GREASE

M-1 SPECIAL
FOR ROLLER BEARING CAR JOURNALS

YOUR Roller Bearing Car Journals Should Be GREASE LUBRICATED

...here's ALL FOUR famous makes of bearings—LUBRIKO LUBRICATED!

THE TEST TELLS

A. A. R.
APPROVED FOR INTERCHANGE

This group of pictures marks a milestone in progress. All four famous makes of bearings are shown with Lubriko Grease lubrication. The pictures were made from trains in actual daily use...not on tests. LUBRIKO M-1 SPECIAL GREASE FOR RAILROADS is past the test stage for car journals—it is now proved and approved for grease lubricated roller bearing car journals of all makes.

The change over from oil to grease can, in most instances, be made without mechanical changes in equipment. The change in terms of dollars saved and efficiency gained means many thousands of dollars to the well-known railroads who are now taking this step.*

You are SAFE with LUBRIKO
THE MASTER LUBRICANT

*ENGINEERING DATA UPON REQUEST

MASTER LUBRICANTS COMPANY PHILADELPHIA, PA.

MANUFACTURERS OF HIGH-GRADE INDUSTRIAL LUBRICANTS FOR OVER 50 YEARS

LOS ANGELES • BOSTON • SAN FRANCISCO

Incorporated 1908 Established 1891

product has resulted in: reduction of dust damage to machinery, instruments, to materials and products during manufacturing operations and storage; less absenteeism, because it provides a cleaner atmosphere; a substantial reduction in maintenance costs; generally increased sanitary conditions.

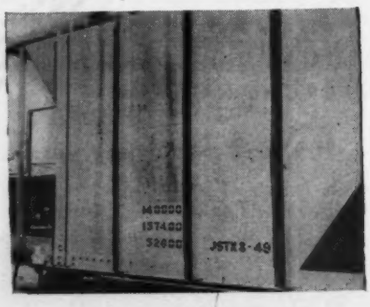
The compound keeps the air free from dust because it is formulated for the preservation of floor surfaces, enhancement of floor beauty, and elimination of dust. This helps prevent the spread of the harmful bacteria and viruses. It removes dust from floors, leaves an antiseptic film which inhibits the growth and multiplication of bacteria. Its surface-sealing film holds down subsequent dust for quick and easy removal.

Antiseptic Westone is easy to apply. One gallon covers 4,000 sq. ft. of floor surface. It is stainless and clean to use with a rag, mop or by spraying. Floor maintenance cost reductions up to 50 per cent have been realized.

Alkali-Resistant Vinylite Resin

Corrosive action of acids, alkalis and other chemicals on railroad hopper cars and similar equipment is forestalled up to six times by a new finish produced by the Sherwin-Williams Company, Cleveland, Ohio, in conjunction with the Bakelite Division, Union Carbide and Carbon Corp., New York 17.

Test cars, as shown in the top illustration, painted with this vinylite resin finish carried cargoes such as cement and soda ash more than three years. They remained almost completely free of corrosion—even



G-E PORTABLE LOADING RESISTOR SIMPLIFIES TESTING

Complete checking, of diesel-electric performance—without moving the locomotive—can be done with the G-E *portable* loading resistor. Tests diesel-engine output, and generator and control performance—quickly, accurately, simply. One man can often do the whole job, and there is no complicated operating or maintenance procedure. Write for further details. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

Shop Motors and Controls • Shop Testing Equipment • Undercar Power Plants • Lighting Systems • Electric Heaters • Signal Power Systems • Power Distribution Systems • Electric and Diesel-Electric Locomotives

GENERAL ELECTRIC

152-16

where sledge hammers had been used to break cargo loose as shown below.

In addition to providing long-life resistance to corrosive effects of acids, soda ash, sulphur, alkalis, phosphate, common salt, and cement, the finish withstands repeated scrubbing and washing with strong cleaning compounds. It has the weather durability of the best grade synthetic enamels as well as unusual abrasion resistance.

Concentrated acids affect the finish to some extent, but not so readily as they affect comparatively short-lived conventional finishes. Aromatic hydrocarbons, ketones, esters and some chlorinated hydrocarbons will soften the finish but as long as no abrasion occurs, the film will harden to its original state when allowed to dry.

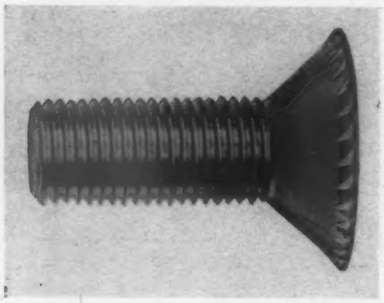
The finish is recommended for use on covered hopper cars, tank cars, tank container cars, refrigerator cars and some other equipment subjected to similar rigorous service conditions. It is applied with the same equipment and technique normally used to apply a synthetic lacquer or enamel.

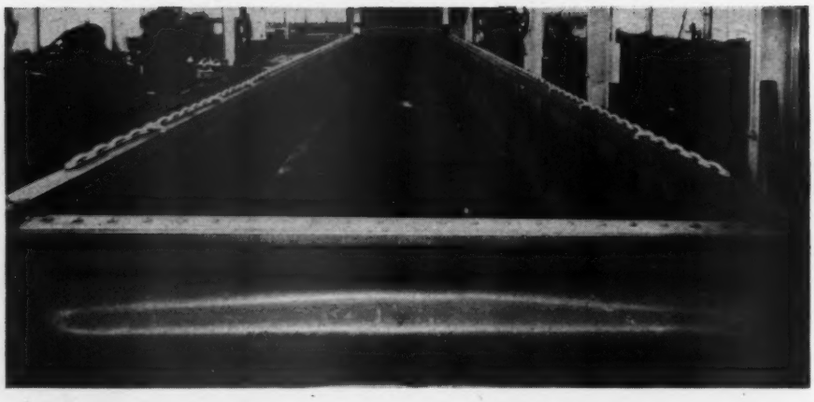
"Washer-Less" Screws

Illustrated here is an innovation in screws, named the Spin-Lock by the maker, the Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y. This screw is available in hex, pan, truss or flat heads which the company recommends for faster, tighter and less costly assembly.

The unusual feature of the screw is its ratchet-like teeth on the underside of the head. This is said to eliminate the time-wasting motion of adding washers.

Being of one piece, with no washer to add, it can be hopper fed. Locking power is positive as there are no parts to cant or fall off. Fastening is neater as the surface is flush and it is safer because there are no protrusions to catch fingers or clothes.





Gondola Lading Band Anchor

Illustrated is a dual purpose development, designed to provide continuous loop locations for sufficient anchorage of lading and to secure and serve as a horizontal reinforcement for the top of car sides.

The anchor, made available by the Wine Railway Appliance Company, Toledo 9, Ohio, offers many possibilities. It can be applied to existing gondolas or flat cars and can also be applied in the design of cars to be built.

This anchor is welded to the top coping of the car, eliminating the cost of replacing when the car sides have to be replaced.

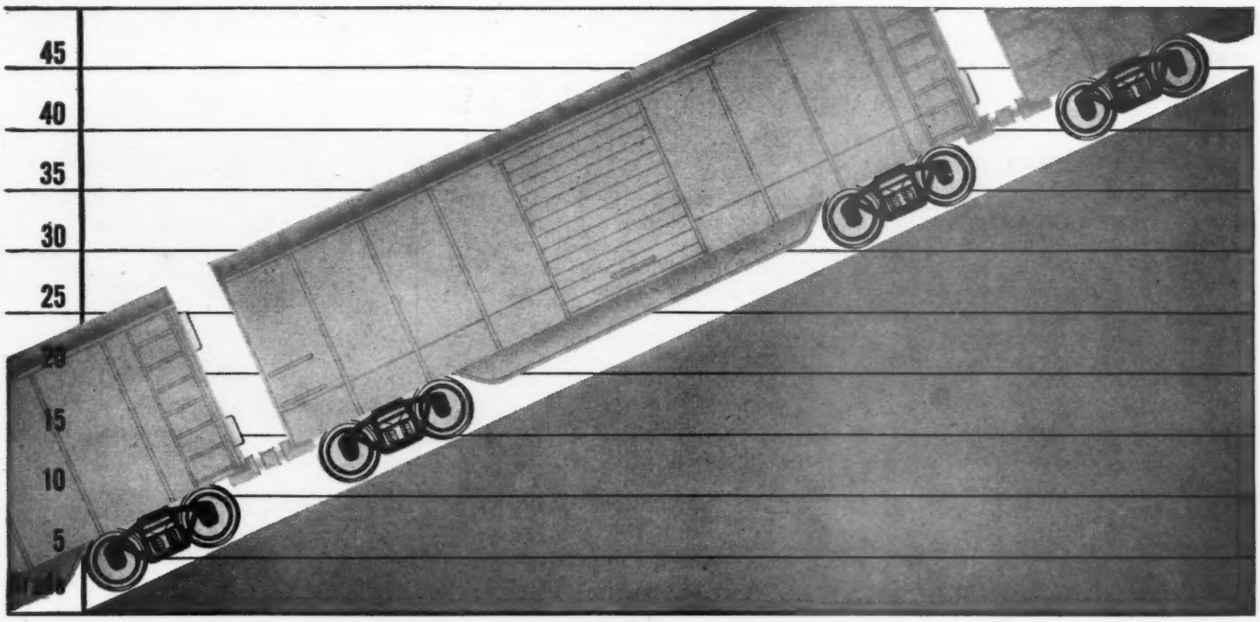
On old cars, it is advisable not to replace the original long reinforcement, if any. The anchor chain is simply applied in the most convenient location. On new cars, the product will provide greater horizontal reinforcement per unit of weight when located on the outside edges than any comparative flat bar fastened to the web of the top angle.

It will accommodate bands or wires and has no sharp corners to sever the anchorage.

Pocket-Size Sound Level Meter

Indoor and outdoor acoustics, machinery noise, and hearing requirements may be measured by a miniature sound level meter, made by Hermon Hosmer Scott, Inc., 385 Putnam avenue, Cambridge 39, Mass. Its flashlight size and simple controls allow operation by non-technical personnel. Subminiature tubes and hearing-aid batteries permit a rugged compact design, meeting the specifications of the American Standards Association for sound level meters.

The meter weighs slightly over 2 lb., covers the range from 34 to 140 db. above the standard A.S.A. weighting characteristics which duplicate the ear response at various loudness levels. Batteries have a normal operating life of 50 hours. Optional accessories include carrying case, extension cable with input adaptor, and mount-



Chilled Car Wheels Pull 45% Grade

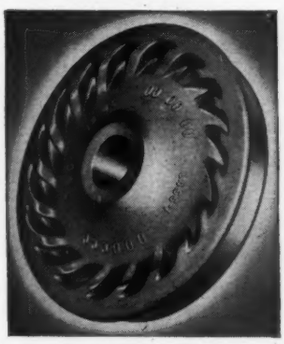
AMCCW chilled car wheels literally "made the grade" shown above . . . a graphic presentation of the improved performance record of AMCCW wheels over the past 15 years. The base used is car miles per wheel without failure, according to ICC reports. In tabular form, it looks like this:

1935-1939	**77,000,000 car miles**
1940-1944	**86,800,000 car miles**
1945-1949	**111,600,000 car miles**

These averages tell only part of the story. In 1949 the record shows 150,000,000 car miles per wheel without failure, well above the five-year average. The 1950 figure, not yet official, matches this excellent 1949 performance.

Nor is this all. The AMCCW wheel you buy today is the new car wheel approved by the AAR in September, 1950, with its heavier rim and stronger flange. All available evidence points toward **even better records** for freight cars equipped with this improved AMCCW car wheel.

The railroad that specifies chilled car wheels today will reap a bonus benefit in the years ahead.



NOW, more brackets—thicker, heavier, more continuous flange support; heavier tread on both rim and flange sides.

Low first cost
Low exchange rates
Reduced inventory
Short haul delivery
Increased ton mileage
High safety standards
Complete AMCCW inspection
Easier shop handling

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

445 North Sacramento Boulevard, Chicago 12, Ill.

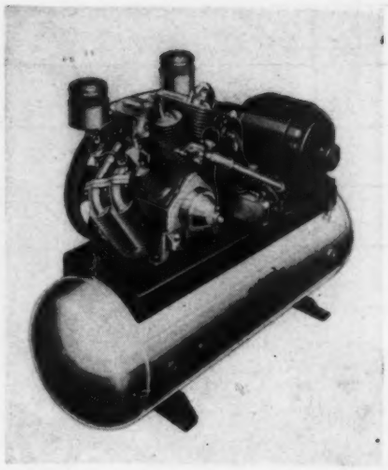
American Car & Foundry Co. • Southern Wheel (American Brake Shoe Co.)
Griffin Wheel Co. • Marshall Car Wheel & Foundry Co. • New York Car Wheel Co.
Pullman-Standard Car Mfg. Co.

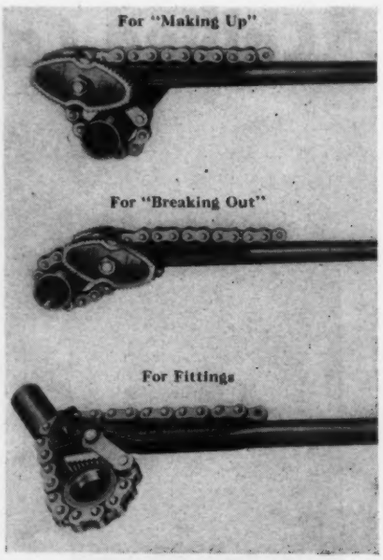
ing tripod. Vibration pickups and integrators are available for measurement of displacements, velocities, and accelerations in the audio frequency range.

Air Compressors

The 3- and 5-hp. compressor units, one of which is shown here, have been redesigned and are different from units of the same size manufactured by the Wayne Pump Company, Fort Wayne 4, Ind. The 3-hp. unit operates at only 455 r.p.m., while the 5-hp. unit has a speed of 650 r.p.m.

Compressors of 3-hp. size are made in both vertical and horizontal types, while the 5-hp. unit is horizontal only. Oil immersed type muffler and filter units are used. Other features include, three matched V belts and a propeller-type flywheel with larger fan blades. The intercooler and aftercooler are directly in the path of air, the cooling system uses oversized copper tubing. A new oiling system assures lubrication even if oil is low in reservoir, avoids over-oiling. The head and cylinder block are removable separately, providing easy access to both cylinders. Screw-feed oil return eliminates gaskets, prevents leaks. Standard with 60-gal. tank either A. S. M. E. as shown or standard tank.





Reversible Pipe Tongs

Without removing the tongs or loosening the chain, "Vulcan" Reversible Tongs made the chain, the "Vulcan" Reversible Tongs made available by J. H. Williams & Co., Buffalo 7, N. Y., will turn pipe in either direction. Since removal of the tongs is unnecessary, no time is lost in reversing the action.

Its outer jaws can be removed to make an efficient fittings device for narrow beads and flanges. Jaw removal is accomplished by taking out the single standard bolt and nut used in assembly. These outer jaws are also reversible end for end.

The reversible tongs are available in four sizes for pipe and fittings from ⅛ to 8 in. All are wholly made from wrought steel, each chain is tested and all parts are interchangeable.